OCTOBER 1961

Journal

VOL. 53 • NO. 10

AMERICAN WATER WORKS ASSOCIATION

Dammed high will be the Upper Colorado when Glen Canyon Project reaches completion

Two parts—Part 1 (AWWA Directory is Part 2):

1961 WATER USE — MacKichan

RECLAMATION IN THE COLORADO BASIN — Dominy

RESOURCES IN MICHIGAN — Billings

GREAT LAKES WATER — Rynders, Miller

HEPATITIS EPIDEMIC — Vogt

CONTAMINATION PREVENTION — Bolton

PEAK DEMANDS — Wolff

DEMAND RATES — Patterson

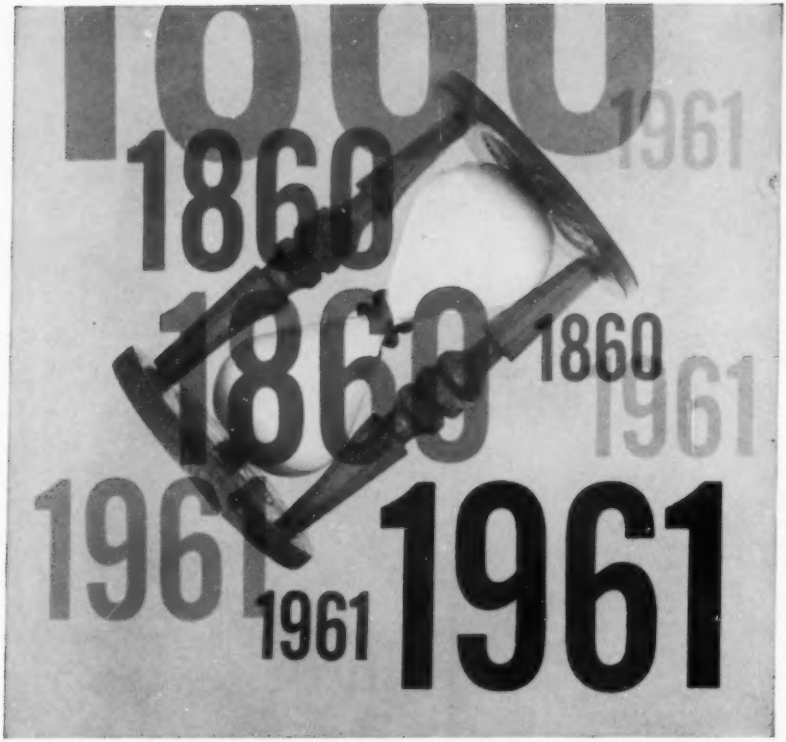
RECRUITING COMPETENT PERSONNEL — Baxter

AWWA PROGRESS — Wertz

ADVANCEMENT AND PUBLIC RELATIONS — Johnson, Murdoch, Finch, Orth

ORGANISMS IN CALIFORNIA SUPPLIES — Palmer

DISTRIBUTION MANUAL — AWWA M8



WHEN BUYING HYDRANTS LOOK FOR A MANUFACTURER WITH AT LEAST 100 YEARS' EXPERIENCE

Age has its advantages when you are dealing with fire hydrants, because hydrants must provide many years of reliable service. When a manufacturer has been in business a hundred years or more, the quality of his products is well known.

R. D. Wood hydrants have stood the test of time. There are more than a million of them in use right now. This says a great deal for the excellence of the product and the reliability of service.

When you deal with R. D. Wood (over 100 years in the hydrant business) you have the comfortable feeling that we will still be around when your equipment needs service or even replacement.

Conform to A.W.W.A. specifications

R. D. WOOD COMPANY

FLORENCE, NEW JERSEY

Established in 1803

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds)

Journal

AMERICAN WATER WORKS ASSOCIATION

2 PARK AVE., NEW YORK 16, N.Y. • Phone: MUrray Hill 4-6686

October 1961
Vol. 53 No. 10

Two Parts
PART 1

Part 2 is
AWWA Directory

Contents

Water Use in the United States, 1960.....KENNETH A. MACKICHAN 1211
Bureau of Reclamation Work in the Colorado River Basin..FLOYD E. DOMINY 1217
Water Resource Problems in Michigan.....NORMAN F. BILLINGS 1225
Monthly Water Bond Interest Costs and Sales..... 1231
Great Lakes as a Water Source.....ARTHUR RYNDERS 1232
Ground Water Quality and Management in the Great Lakes Area
LYNN M. MILLER 1235
Infectious Hepatitis Epidemic at Posen, Mich. .....JOHN E. VOGT 1238
Prevention of Water Source Contamination.....PAUL BOLTON 1243
Peak Demands in Residential Areas.....JEROME B. WOLFF 1251
Demand Rates for Water Service.....WILLIAM L. PATTERSON 1261
Recruiting and Keeping Competent Engineering and Management Personnel
SAMUEL S. BAXTER 1269
Forty Years of AWWA Progress.....C. F. WERTZ 1273
AWWA Advancement Program—*Joint Discussion*
ERIC F. JOHNSON, JOHN H. MURDOCH JR. & LEWIS S. FINCH 1277
WSWMA Public Relations Program.....ROBERT F. ORTH 1292
Algae and Other Interference Organisms in Water Supplies of California
C. MERVIN PALMER 1297
A Training Course in Water Distribution—AWWA M8
Chapter 6—Customer Service Lines..... 1313
Reprints Available 1323
Annual Report of Joint Committee on Uniformity of Methods of Water Examination 1324

Departments

Officers and Directors..... *2 P&R*
Coming Meetings..... *6 P&R*
Percolation and Runoff..... *41 P&R*
Employment Information..... *60 P&R*
Condensation ..... *72 P&R*
Correspondence ..... *98 P&R*

RAYMOND J. FAUST, *Exec. Secretary*
LAWRENCE FARBER, *Asst. Director of Pubs.*
MILTON HOROWITZ, *Associate Editor*
ERIC F. JOHNSON, *Director of Publications*
ROBERT A. NYE, *Advertising Manager*
JAMES E. MARTIN, *Assistant Editor*

Journal AWWA is published monthly at Prince & Lemon Sts., Lancaster, Pa., by the Am. Water Works Assn., Inc., 2 Park Ave., New York 16, N.Y. Second-class postage paid at Lancaster, Pa. Authorized Aug. 6, 1918. $8.00 of members' dues are applied as a subscription to the JOURNAL; additional single copies—85 cents. Indexed annually in December; and regularly by *Industrial Arts Index* and *Engineering Index*. Microfilm edition (for JOURNAL subscribers only) by University Microfilms, Ann Arbor, Mich.

© 1961, by the American Water Works Association, Inc. Made in U.S.A.

AWWA Officers and Directors

President	JOHN W. CRAMER	*Ch. Education Com.*	HERBERT E. HUDSON
Vice-President	WILLIAM D. HURST	*Ch. Research Com.*	THURSTON E. LARSON
Past-President	C. F. WERTZ	*Treasurer*	WILLIAM J. ORCHARD
Ch. Standardization Com.	LOUIS R. HOWSON	*Executive Secretary*	RAYMOND J. FAUST
Ch. Professional & Adm. Practice Com.	WENDELL R. LADUE	*Asst. Secretary*	ERIC F. JOHNSON
Ch. Tech. Program Com.	E. SHAW COLE	*Asst. Secretary*	JAMES B. RAMSEY
		Asst. Secretary	DAVID B. PRESTON

Officers of the Sections

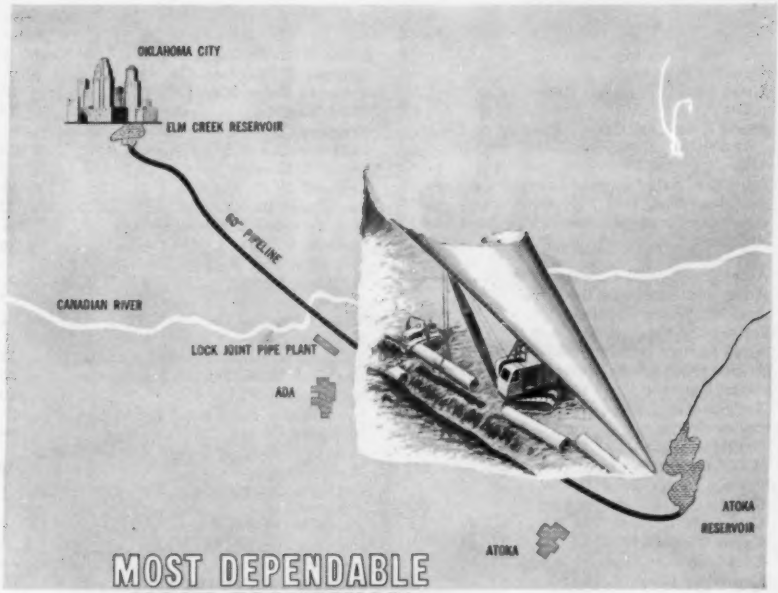
Section	*Director*	*Chairman*	*Vice-Chairman*	*Secretary-Treasurer*
Alabama-Miss.	J. L. Haley	C. M. Mathews	C. C. Williams	Ernest Bryan
Arizona	L. O. Gardner	S. I. Roth	—	A. D. Cox
California	H. C. Medbery	M. K. Socha	H. J. Ongerth	F. F. Watters
Canadian	H. P. Stockwell	G. E. Maxwell	Lucien L'Allier	A. E. Berry
Chesapeake	B. L. Werner	R. L. Orndorff	D. H. Goldsborough	C. J. Lauter
Connecticut	E. A. Bell	W. N. MacKenzie	J. E. Riordan	D. W. Loiselle
Cuban	L. Plana Astienza	R. Garcia Montes	L. de Goicochea	L. H. Daniel
Florida	J. R. Kelly	C. H. Stanton	C. A. Black	J. B. Miller
Illinois	H. R. Frye	K. A. Steel	W. J. Downer	D. W. Johnson
Indiana	Leo Louis	H. A. Kerby	R. J. Becker	C. H. Canham
Intermountain	C. W. Wilson	W. C. Hague	E. J. Fjeldsted	M. W. Snell
Iowa	M. E. Driftmier	H. F. Seidel	F. L. Wehrle	W. E. Bjork
Kansas	G. D. Pelton	O. R. Green	H. R. Volkmann	F. H. McBride
Kentucky-Tenn.	J. J. Davis	J. D. Boxley	L. H. Clouser	H. F. Mount
Michigan	H. O. Self	Gerald Remus	Albert Sabo	T. L. Vander Velde
Missouri	V. C. Lischer	F. E. Dolson	G. F. Ferrel	W. A. Kramer
Montana	Kurt Wiel	F. B. Taylor	E. R. Dodge	A. W. Clarkson
Nebraska	G. H. Beard	J. J. Rossbach Jr.	G. H. Allen	C. W. Durham
New England	K. R. Kennison	W. H. McGinness	W. D. Monie	R. M. Soule
New Jersey	R. E. Bonyun	P. E. Pallo	G. L. E. Linn	A. F. Pleibel
New York	J. M. Diven	E. J. Clark	G. E. Symons	Kimball Blanchard
North Carolina	S. E. Harris	L. P. Bloxam	J. H. Henderlite	T. Z. Osborne
North Central	M. D. Lubratovich	W. J. Bell	Paul Buccowich	C. A. Flack
Ohio	M. W. Tatlock	Franklin Ruck	R. R. Deem	J. H. Bass
Pacific Northwest	W. H. Berkeley	R. W. Struthers	R. W. Morse	F. D. Jones
Pennsylvania	S. S. Baxter	S. S. Baxter	J. A. Murphy	L. S. Morgan
Rocky Mountain	W. F. Turney	Ernest Martinez	E. B. Ambler	H. F. Kepner
South Dakota	W. B. Campbell	W. P. Wells	Don Wessell	J. D. Bakken
Southeastern	R. C. Kauffman	M. E. Henley	A. M. Johnstone	N. M. deJarnette
Southwest	J. E. Williams	G. T. Kellogg	W. R. Hardy	L. A. Jackson
Virginia	H. A. Johnson	J. B. Ferguson	J. G. Jones	E. H. Ruehl
West Virginia	C. C. MacDonald	J. S. Hugart	J. H. Millar	T. J. Blair III
Wisconsin	T. M. McGuire	E. W. Becker	J. H. Kuranz	Harry Breimeister

Directors Representing the Water and Sewage Works Manufacturers Assn.

E. E. Alt — R. V. Ford — G. W. Kelsey

Officers of the Divisions

Division	*Chairman*	*Vice-Chairman*	*Secretary*
Water Distribution	J. G. Carns Jr.	A. H. Rice	E. B. Cobb
Water Purification	J. M. Sanchis	A. H. Ullrich	H. P. Kramer
Water Resources	L. M. Miller	I. E. Anderson	G. H. Beard
Water Utility Management	C. W. Wilson	John Copley	P. C. Karalekas



MOST DEPENDABLE
MOST ECONOMICAL
FOR THE
LONG
HAUL!

When a city must go 100 miles for a sufficient supply of potable water, authorities demand a reliable medium for its transmission to the community. That's why Oklahoma City selected LOCK JOINT PRESTRESSED CONCRETE EMBEDDED CYLINDER PIPE to carry its vital supply of pure water from Atoka Reservoir to the state's capital.

The long life, permanent high carrying capacity and negligible maintenance inherent in Lock Joint Concrete Pressure Pipe make it ideal for the construction of this 60" aqueduct —the longest continuous water line ever built in the United States.

Economically, Lock Joint Pipe is also ideal. In addition to long term savings effected in low pumping costs and minimum maintenance, the production of the pipe locally at Ada will plow back more than $6,000,000 into the economy of the area through the use of local labor, services and materials.

LOCK JOINT PIPE CO.
Established 1905
P. O. BOX 269, EAST ORANGE, N. J.

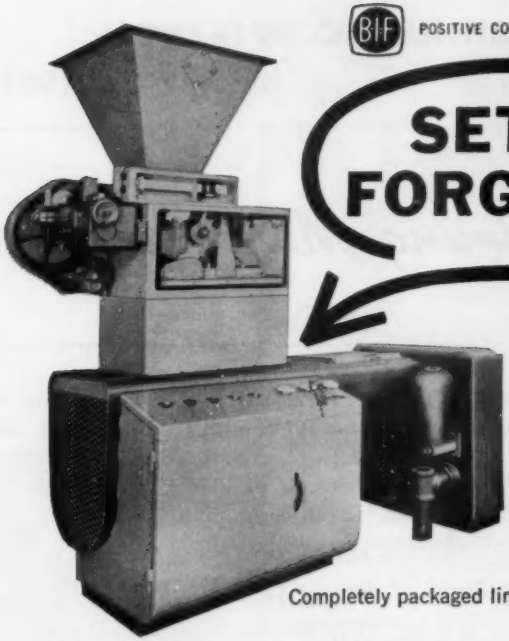
Member of The American Concrete Pipe Association and The American Concrete Pressure Pipe Association
CONCRETE PRESSURE, SEWER, CULVERT & SUBAQUEOUS PIPE • PLASTIC PIPE AND PROTECTIVE COATINGS

LIST OF ADVERTISERS

	P&R PAGE
Ace Pipe Cleaning, Inc.	93
Alabama Pipe Co.	—
Allied Chemical Corp., General Chemical Div.	11
Allied Chemical Corp., Plastics & Coal Chemicals Div.	—
Allis-Chalmers Mfg. Co.	33, 79
American Agricultural Chemical Co.	84
American Cast Iron Pipe Co.	62, 63
American Concrete Pressure Pipe Assn.	76, 77
American Cyanamid Co., Process Chemicals Dept.	24
American Pipe & Construction Co.	23
Anaconda American Brass Co.	25
Andrich Water Specialty Co.	—
Anthracite Equipment Corp.	—
Aqua Survey & Instrument Co.	98
Armco Drainage & Metal Products, Inc.	91
Atlas Asbestos Co. Ltd.	—
Badger Meter Mfg. Co.	55
Bailey Meter Co.	22
Bethlehem Steel Co.	34
B-I-F Industries, Inc.	5, 26
Buffalo Meter Co.	15
Calgon Co.	27
Carborundum Co., The	—
Carus Chemical Co.	18, 19
Cast Iron Pipe Research Assn., The	36, 37
Centriline Corp.	—
Chain Belt Co.	14
Chapman Valve & Mfg. Co.	—
Charles Machine Works, Inc.	10
Chase Manhattan Bank	20
Chicago Bridge & Iron Co.	28
Clow, James B., & Sons	7
Cotey Chemical Co.	80
Darley, W. S., & Co.	102
Darling Valve & Mfg. Co.	83
De Laval Steam Turbine Co.	—
DeZurik Corp.	—
Dorr-Oliver Inc.	Cover 3
Dresser Mfg. Div.	35
Eddy Valve Co.	7
Electro Rust-Proofing Corp.	—
Ellis & Ford Mfg. Co.	—
Fairbanks, Morse	—
Filtration Equipment Corp.	—
Fischer & Porter Co.	53
Flintkote Co., The, Orangeburg Div.	—
Ford Meter Box Co., The	110
Foxboro Co.	—
Gamon Meter Div., Worthington Corp.	45
General Chemical Div., Allied Chemical Corp.	11
General Filter Co.	30
Glenfield & Kennedy	—
Golden-Anderson Valve Specialty Co.	—
Graver Tank & Mfg. Co.	—
Hagan Chemicals & Controls, Inc.	—
Halliburton Co.	—
Harco Corp.	90
Hays Mfg. Co.	50
Hersey-Sparling Meter Co.	89
Hungerford & Terry, Inc.	78
Industrial Chemical Sales Div., West Virginia Pulp & Paper Co.	39
Inertol Co., Inc.	—
Infilco Inc.	43
International Salt Co.	16
Iowa Valve Co.	7
Johns-Manville Corp.	Cover 4
Keasbey & Mattison Co.	—
Kennedy Valve Mfg. Co., The	49
Klett Mfg. Co.	82
Koppers Co., Inc.	—
LaMotte Chemical Products Co.	102
Layne & Bowler, Inc.	57
Leopold, F. B., Co.	47
Lock Joint Pipe Co.	3
M & H Valve & Fittings Co.	107
Martin, Robert E.	56
Met Pro, Inc.	—
Millipore Filter Corp.	—
Mueller Co.	97
Nalco Chemical Co.	58, 59
National Power Rodding Corp.	—
National Tank Maintenance Corp.	31
National Water Main Cleaning Co.	81
Neptune Meter Co.	40
North American Mogul Products Co.	21
Northern Gravel Co.	96
Olin Mathieson Chemical Corp. (Mathieson Chemicals)	32
Orangeburg Mfg. Co., Div. of The Flintkote Co.	—
Ozark-Mahoning Co.	—
Peerless Pump Div.	51
Permutit Co.	94, 95, 100
Philadelphia Quartz Co.	74
Photovolt Corp.	101
Pilot Mfg. Co.	88
Pipe Linings, Inc.	71
Pittsburgh-Des Moines Steel Co.	9
Pittsburgh Equitable Meter Div. (Rockwell Mfg. Co.)	75
Plastics & Coal Chemicals Div., Allied Chemical Corp.	—
Pollard, Jos. G., Co., Inc.	38
Portland Cement Assn.	—
Pratt, Henry, Co.	—
Preload Co., Inc.	109
Pulsation Controls Corp.	—
Robinson Pipe Cleaning Co.	—
Rockwell Mfg. Co.	75
Rohm & Haas Co.	—
Ronald Press Co.	—
Ross Valve Mfg. Co.	—
Servicised Products Corp.	—
Simplex Valve & Meter Co.	—
Smith, A. P., Mfg. Co., The	61
Southern Pipe Div. of U.S. Industries	99
Steel Plate Fabricators Assn.	103
Tennessee Corp.	105
Tinker & Rasor	85
Trinity Valley Iron & Steel Co.	73
U.S. Pipe & Foundry Co.	12, 13
University of Chicago Press	—
Wachs, E. H., Co.	—
Walker Process Equipment, Inc.	—
Wallace & Tiernan Inc.	86, 87
West Coast Wood Tank Association	—
Wheeler Mfg. Corp.	54
Wheeler, C. H., Mfg. Co.	17
Wiley, John, & Sons, Inc.	56
Willamette Iron & Steel Co.	—
Wood, R. D., Co.	Cover 2
Woodward Iron Co.	29
Worthington Corp.	—

Directory of Professional Services—pp. *64–70 P&R*

B·I·F POSITIVE CONTROL OF MATERIALS FLOW



SET IT!
FORGET IT!

POSITIVE CONTROL SLAKER SAVES LIME AND TIME!

Completely packaged lime slaking system

B-I-F's PUG MILL SLAKER, started empty or full . . . using any grade of commercial lime meeting AWWA Standards . . . produces lime slurry of desired consistency . . . automatically, unattended. Positive water ratio control at all rates . . . any change in feeder rate instantly matched by change in water rate. Low water-to-lime ratio produces higher slaking temperatures for top efficiency. Unit slakes with cold water . . . eliminates need for hot water supply or heat exchangers. Other features include continuous grit removal, constant vapor removal, and console-mounted controls.

FREE FACT BOOK Request data on the most advanced, performance-proved slaker available. Maximum capacities of 1,000 and 4,000 lbs./hr. . . . over 20:1 range. Write for free fact book today! **B-I-F Industries, 365 Harris Ave., Providence 1, Rhode Island.**

B·I·F Industries
A DIVISION OF THE NEW YORK AIR BRAKE COMPANY

METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

Plan now for

AWWA ANNUAL CONFERENCE

Philadelphia, Pa. June 17–22, 1962

Coming Meetings

AWWA SECTIONS

Fall 1961

Oct. 25–27—California Section, at Hotel Senator, Sacramento. Secretary, Frank F. Watters, Hydr. Engr., State Public Utilities Com., State Bldg., Civic Center, San Francisco.

Oct. 25–27—Ohio Section, at Commodore Perry Hotel, Toledo. Secretary, J. H. Bass, Henry P. Thompson Co., 4866 Cooper Rd., Cincinnati.

Oct. 25–28—New Jersey Section, at Dennis Hotel, Atlantic City. Secretary, A. F. Pleibel, District Sales Mgr., R. D. Wood Co., 683 Prospect St., Maplewood.

Oct. 29–Nov. 1—Florida Section, at Cherry Plaza Hotel, Orlando. Secretary, John B. Miller, Director, Div. of Water Supply, Bureau of San. Eng., State Board of Health, Box 210, Jacksonville 1.

Nov. 1–3—Chesapeake Section, at Emerson Hotel, Baltimore, Md. Secretary, Carl J. Lauter, 6955—33rd St., N.W., Washington, D.C.

Nov. 13–15—North Carolina Section at George Vanderbilt Hotel, Asheville. Secretary, T. Z. Osborne, Asst. Director of Public Works, Box W-2, Greensboro.

Spring 1962

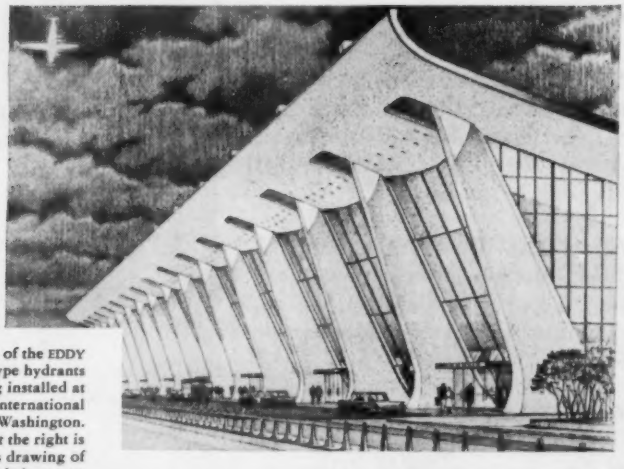
Jan. 23—New York Section, Luncheon Meeting at Statler-Hilton Hotel, New York, N. Y. Secretary, Kimball Blanchard, Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Feb. 7–9—Indiana Section, at Sheraton-Lincoln Hotel, Indianapolis. Secretary, Chester H. Canham, State Board of Health, 1330 W. Michigan St., Indianapolis 7.

Mar. 15—New England Section, at Statler Hotel, Boston, Mass. Secretary, Ralph M. Soule, San. Engr., State Dept. of Public Health, 511 State House, Boston, Mass.

Apr. 5–7—Montana Section at Bozeman. Secretary, A. W. Clarkson, Div. of Environmental Sanitation, State Board of Health, Helena.

(*Continued on page 8*)



One of the EDDY flush type hydrants being installed at Dulles International Airport, Washington. At the right is artist's drawing of fabulous new terminal building.

"Gateway to America" installs

EDDY

Hydrants and Valves

to serve new jet-age airport

A jet-age showplace is taking shape in Virginia, just a few miles from the capital...the new Dulles International Airport, which the Federal Aviation Agency has called the "Gateway to America."

Material for every facility at this multi-million dollar airport has been selected with the utmost care and meets federal specifications. The choice of EDDY hydrants and valves for controls in this all-important waterworks and fire protection system is a tribute to the precise, long-life performance of these products.

EDDY valves and hydrants have provided uninterrupted service in hundreds of communities for 40, 60, 80 years and longer. Yet, the certainty of continuous availability of replacement parts assures that an EDDY-equipped waterworks system is always up-to-date. EDDY valves and hydrants meet all AWWA standards and are available to fit any existing or planned installation.

SEND TODAY for information on the complete line of EDDY Valves, Hydrants and other waterworks specialties

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.

WATERFORD NEW YORK

Coming Meetings

(Continued from page 6)

Apr. 11–12—New York Section, at Manger DeWitt Clinton Hotel, Albany. Secretary, Kimball Blanchard, Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Apr. 12–13—West Virginia Section, at Hotel Morgan, Morgantown. Secretary, Thomas J. Blair III, Kelley, Gidley, Staub, Inc., 5418 Mac Corkle Ave., S.W., Charleston.

Apr. 15–18—Southeastern Section, at Wanderer Resort Motel, Jekyll Island, Ga. Secretary, N. M. deJarnette, Robert & Co. Assocs., 96 Poplar St., N.W., Atlanta, Ga.

Apr. 24–26—Nebraska Section. Secretary, Charles W. Durham, Cons. Engr., Henningson, Durham & Richardson, 2963 Harney, Omaha.

Apr. 27—California Section, at Ahwahnee Hotel, Yosemite Valley. Secretary, Frank F. Watters, Hydr. Engr., Public Utils. Com., State Bldg., Civic Center, San Francisco.

Apr. 29–May 3—Canadian Section, at Royal York, Toronto, Ont. Secretary, A. E. Berry, 72 Grenville St., Toronto, Ont.

May 2–4—Kansas Section, at Lassen Hotel, Wichita. Secretary, F. Harry McBride, Sales Engr., B-I-F Industries, 2108 W. 75th St., Prairie Village.

May 3–5—Arizona Section, at Pioneer Hotel, Tucson. Secretary, A. D. Cox Jr., Secy. & Comptroller, Arizona Water Co., Box 5347, Phoenix.

May 30–June 2—Pacific Northwest Section, at Olympic Hotel, Seattle, Wash. Secretary, Fred D. Jones, W. 2108 Maxwell Ave., Spokane, Wash.

OTHER ORGANIZATIONS

Nov. 13–17—APHA, Cobo Hall, Detroit, Mich.

Nov. 26–Dec. 1—ASME Winter Annual Meeting, Statler-Hilton Hotel, New York, N.Y.

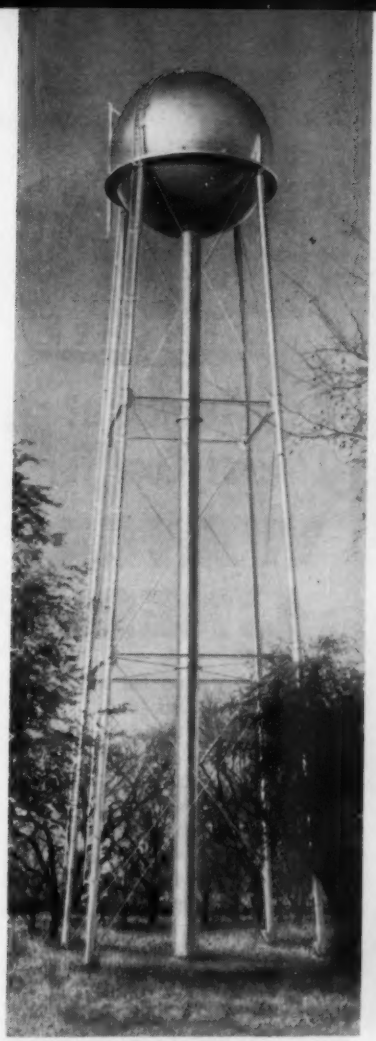
Nov. 27–Dec. 1.—28th Exposition of Chemical Industries, Coliseum, New York, N.Y.

SHORT COURSES

Nov. 6–10—Training course on "Radioactive Pollutants in Water," R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Write: Chief, Training Program, 4676 Columbia Pkwy., Cincinnati 26, Ohio (or to USPHS regional office).

Nov. 13–17—Training course on "Radionuclides in Water," R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Write: Chief, Training Program, 4676 Columbia Pkwy., Cincinnati 26, Ohio (or to USPHS regional office).

Dec. 4–15—Training course on "Chemical Analyses for Water Quality," R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Write: Chief, Training Program, 4676 Columbia Pkwy., Cincinnati 26, Ohio (or to USPHS regional office).



Scranton, Kansas. 50,000-gallon capacity. 100 ft to bottom.

SMALL IN CAPACITY... LOW IN COST... BIG IN DEPENDABLE SERVICE!

THE WATERBALL® BY PITTSBURGH-DES MOINES

Bigelow, Minnesota. 15,000-gallon capacity. 75 ft to bottom.

Auburn, Kansas. 50,000-gallon capacity. 68 ft to bottom.

Take a sturdy steel sphere—place it in a ring of structural steel—support the ring with tubular steel columns—*do the job with sound PDM craftsmanship*, and you have the WATERBALL.

These recent installations prove again that within the range of smaller capacity demands, there's no bigger value than the PDM Waterball for dependable elevated water storage. *Let us detail the facts for you, without obligation.*

PDM ELEVATED STEEL TANKS

PITTSBURGH-DES MOINES STEEL CO.

Plants at PITTSBURGH, WARREN, BRISTOL, PA. • BALTIMORE • BIRMINGHAM • DES MOINES PROVO, UTAH • CASPER, WYO • SANTA CLARA, FRESNO, STOCKTON, CALIF.

Sales Offices

PITTSBURGH (25).....Neville Island	EL MONTE, CALIF.....P. O. Box 2012
WARREN, PA.....P. O. Box 660	NEW YORK (17).....200 East 42nd Street
BALTIMORE (26).P. O. Box 3459, Curtis Bay Station	NEWARK (2).....744 Broad Street
BIRMINGHAM (8)....P. O. Box 8641, Ensley Station	CHICAGO (3)..679 First National Bank Bldg.
DES MOINES (8).....1015 Tuttle Street	ATLANTA (5).361 East Paces Ferry Rd., N.E.
PROVO, UTAH.....P. O. Box 310	DALLAS (1)....Suite 1703, Southland Center
SANTA CLARA, CALIF.....P. O. Box 329	DENVER (2)....323 Railway Exchange Bldg.
SEATTLE (1).....500 Wall Street	

NEW Crawler

DITCH WITCH TRENCHER

Trench at Lowest Cost for

WATER LINES!

Slash costs on water line trenching with the new track model Ditch Witch . . . built to give you extra traction and flotation, with easy steering and high maneuverability. Its added weight suits it to frosty or rocky conditions. The crawler Ditch Witch does a straight-line job of trenching, digging from 4" to 12" wide . . . up to 5' cover!

12 HP Crawler Model M-322 CR shown here. Choice of track or rubber-tire in both 9 and 12 HP!

DITCH WITCH

rubber-tire models in other sizes from 7 to 30 HP dig up to 16" wide and up to 6' deep. The 30 HP Hydraulic Drive K-1 is pictured below.

Mfd. by

CHARLES

Machine Wks., Inc.

649 Birch St. • Perry, Okla.

Call Collect: FE 6-4404

Multiple Sources— Extra Reliability!

...when you call on

GENERAL CHEMICAL for ALUM!

In the Great Lakes region alone, for example, General Chemical has ten plants to serve Alum consumers with speed, efficiency... and certainty. Similar multi-source supply patterns exist in other major consuming areas. Your local General Chemical office will be glad to show you how any of the following alum plants can be put to work for you:

Atlanta, Ga. • Barnet, B. C.* • Chillicothe, O. • Cleveland, O. • Denver, Colo. • Detroit, Mich. • E. St. Louis, Ill. El Segundo, Calif. • Hopewell, Va. • Jacksonville, Fla. • Johnsonburg, Pa. • Kalamazoo, Mich. • Kennewick, Wash. • Macon, Ga. • Marcus Hook, Pa. • Menasha, Wis. • Middletown, O. • Monroe, La. • New Orleans, La. Pine Bluff, Ark. • Port Arthur, Ont.* • Port St. Joe, Fla. • San Francisco (Port Chicago) Calif. • Savannah, Ga. Tacoma, Wash. • Thorold, Ontario* • Vancouver, Wash. • Wisconsin Rapids, Wis. • Valleyfield, Quebec*

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

*In Canada: Allied Chemical Canada, Ltd.

"All you're gonna do is
scare the fish cousin Ferd...
you ain't goin' to find
no leaks in them joints"

U.S. cast iron **PIPE** FOR WATER, SEWERAGE AN

not a leak in a lakeful!

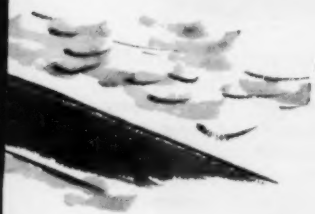
The joints on USIFLEX® Boltless Flexible Joint Pipe are bottle-tight. Joint is made up with a moderate thrust to move ball past self-sealing gasket in socket. Rugged retainer ring locks joint against pull-out during installation and in service. And no wrenches, bolts or nuts to worry about.

Underwater jobs are never easy. But Usiflex simplicity, speed and ease of handling make them almost a pleasure. Want to cut costs, save time and labor next time you have a tough underwater job? Call or write today for illustrated technical brochure on Usiflex.

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

Makers of TYTON JOINT® Pipe.



USIFLEX
BOLTLESS FLEXIBLE JOINT* PIPE

*U. S. Patent No. 2,864,988

1 Insert the gasket in its seat in the socket. Forming gasket loop helps initial stage of seating. Release of loop allows gasket to spring into the gasket seat where it is securely held.

2 Apply special Usiflex lubricant to the ball and inside surface of seated gasket in socket. After lubrication, ball is ready to be pushed into socket.

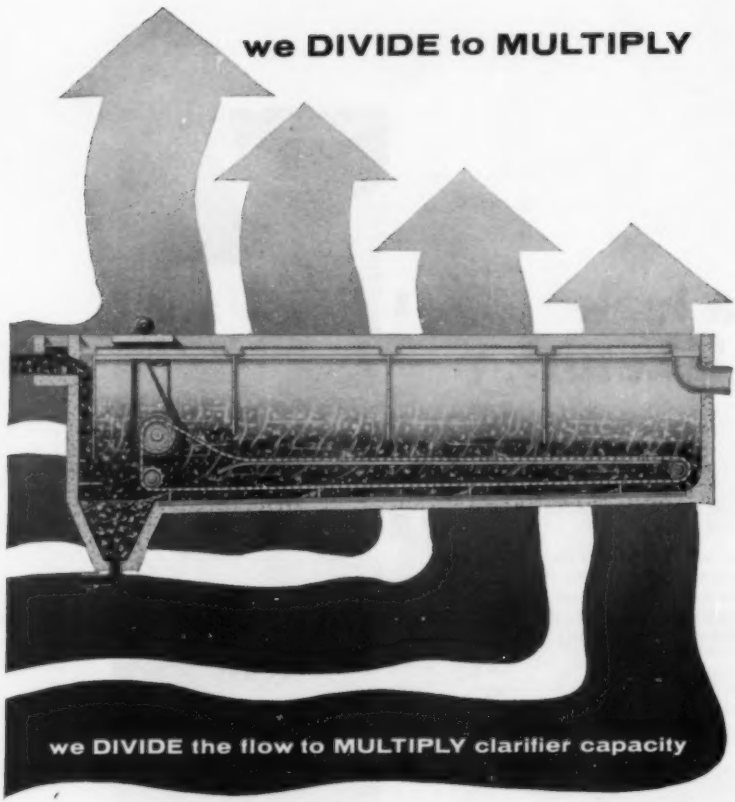
3 Ball has been socketed. Retainer ring lugs have been lined up with recesses in bell and retainer ring is ready to be moved into the bell and rotated.

4 After insertion and rotation of retainer ring in bell, the lugs on retainer ring are in back of and in register with internal flange segments in bell. Lead lock is partially inserted into recess between the bell and retainer ring.

5 Lead lock completely inserted in recess is being caulked in place by hammer blows on a wide caulking iron.

INDUSTRIAL SEP

we DIVIDE to MULTIPLY



Rex Verti-Flo not only increases the clarifying capacity of tanks up to four times; it provides a far clearer effluent. The savings in equipment and construction costs are obvious. Here's how Verti-Flo does it:

The unique design of Rex Verti-Flo Clarifier transforms the conventional horizontal-flow tank into a vertical-flow tank...utilizing the *full volume* of the tank and *minimizing short-circuiting*. This is accomplished by a system of collecting troughs, weirs and partitioning baffles which divide the large, horizontal settling zone into a series of small, vertical-flow cells. To assure maximum flow length and control, the weirs are adjustable around the periphery of each cell.

Installed in existing tanks, Verti-Flo can be at least double the capacity of the tank...in new installations, Verti-Flo provides up to four times more capacity so that smaller basins can be used with considerable savings in both equipment and construction costs.

For complete information, write CHAIN Belt Company, 4609 W. Greenfield Ave., Milwaukee 1, Wis.

REX®

CHAIN BELT COMPANY

NOW YOU CAN SELECT AN

AMERICAN METER

TO MEET YOUR WATER CHEMISTRY

Yes, now you can literally "build" an American Meter specially designed to meet your water conditions. You know the chemical contents of your water. You know what you need to counteract these contents to keep your water meters accurate and trouble-free.

Only **AMERICAN** *Offers a Choice of:*

Sealed or standard register box. • 3 piece or 1 piece measuring disc. • Oil-enclosed or chrome shell gear train. • Reinforced or thrust-roller disc insert. • Bronze or nickel alloy measuring chamber. • Frost bottom of breakable bronze or galvanized cast iron. • 3 housing styles — frost bottom, split case or solid case construction.

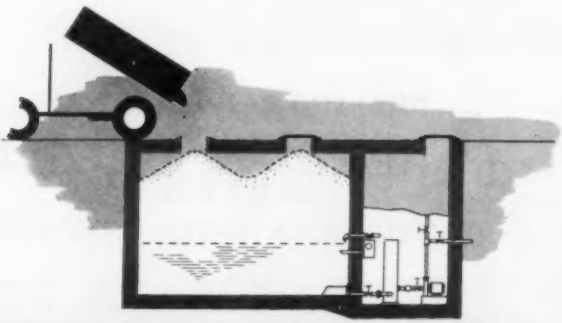
Look over the alternate materials and design features. Remember, AMERICAN bronze water meters meet all of the AWWA requirements. If you are in doubt about which to choose, our engineers will be glad to assist you. Our interest is to provide a water meter that will give unequalled accuracy, and long life. We're doing it for others — why not let us do it for you!

For Complete Details, write for Bulletin 58

BUFFALO METER COMPANY, INC.
Dept. AW, 2917 Main Street • Buffalo 14, N. Y.
300 North Gilbert Avenue • Fullerton, Calif.

Sales representatives throughout the nation

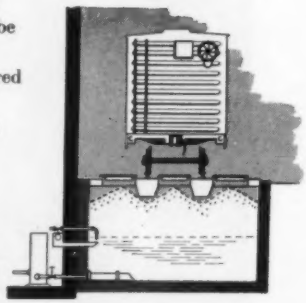
Subsidiary of
American Meter
Company



SALT DELIVERY

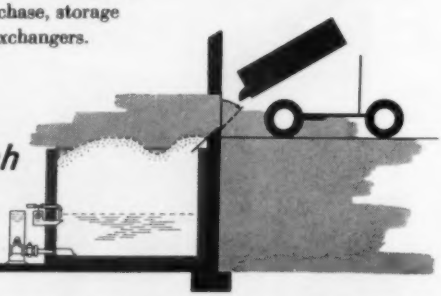
How it can affect design of water softening installations

Every method of salt delivery—by rail, truck or barge, in bags or bulk—presents it own special problems of plant design. For example: What plant area should be designated for receiving salt? What's the best salt-unloading method to specify? Where will salt be stored and dissolved to make brine? The job of answering these questions has been complicated in recent years by the greatly increased salt tonnages required in today's large-capacity water-softening installations.

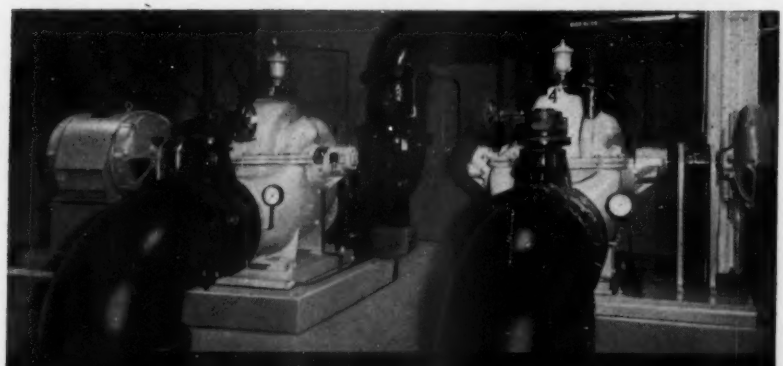


If you foresee a plant-design problem involving salt delivery, contact International Salt Company. With over 50 years of experience and continuing research in all phases of salt handling and brine production, International is fully prepared to give you expert, comprehensive information and technical assistance on any matter in connection with salt purchase, storage and dissolving for regeneration of ion exchangers. This service is free of charge.

Service and research are the extras in STERLING SALT



INTERNATIONAL SALT COMPANY, CLARKS SUMMIT, PA. • **Sales Offices:** Boston, Mass. • Buffalo, N. Y. Charlotte, N. C. • Chicago, Ill. • Cincinnati, O. • Detroit, Mich. • Newark, N. J. • New Orleans, La. New York, N. Y. • Philadelphia, Pa. • Pittsburgh, Pa. • St. Louis, Mo.



"Push-Button" WATER TREATMENT PLANT USES C.H. WHEELER PUMPS

● At the ultra-modern water treatment plant in the Torresdale section of Philadelphia, automatic and semi-automatic controls direct water flow, sedimentation, filtration, chemical treatment, feeding rates, and all other operations.

One operator by flipping a few switches automatically controls the cleaning of four filter beds simultaneously—*AND THE OPERATION TAKES ONLY HALF AN HOUR.*

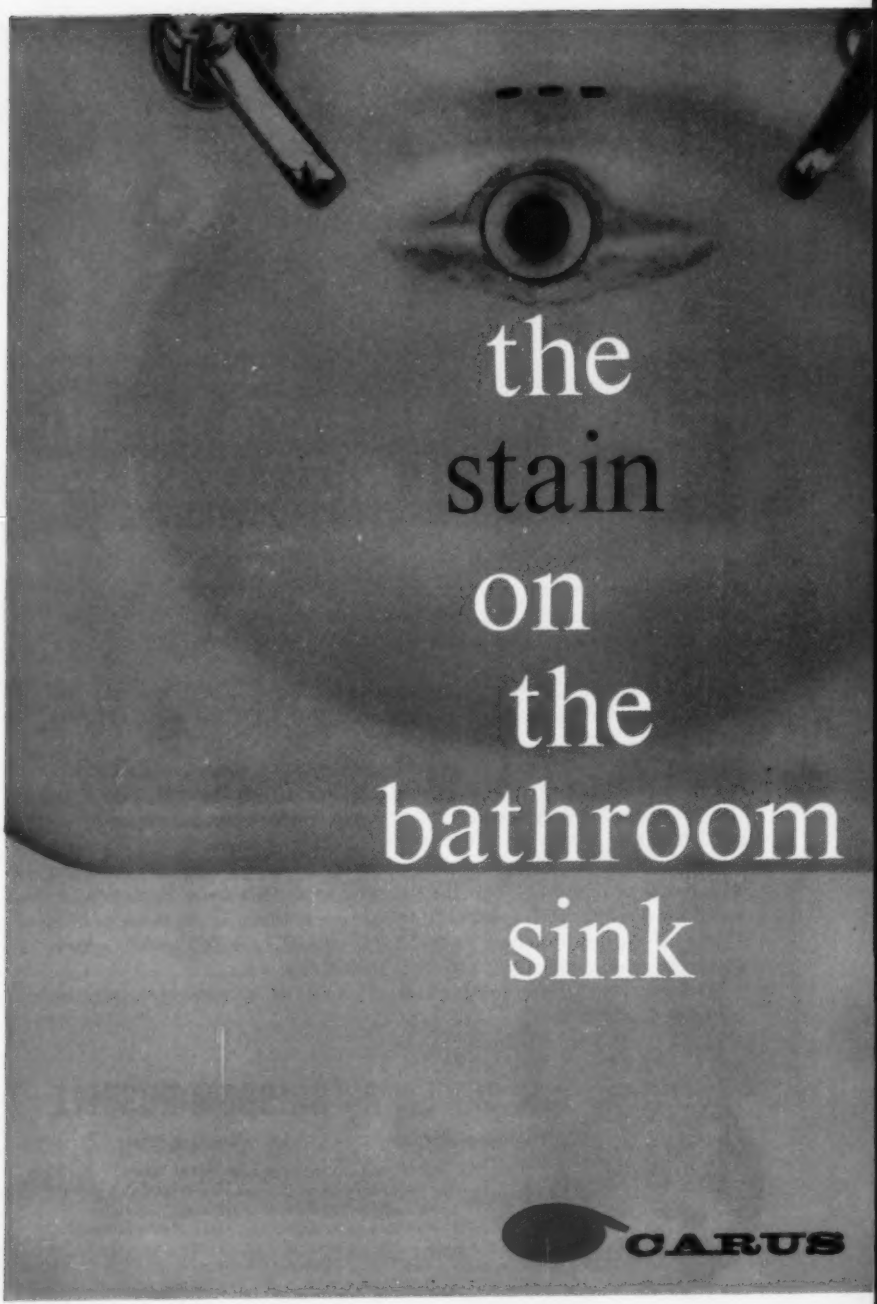
Four C. H. Wheeler 24″ x 20″ Horizontally Split Case Double Suction Pumps (witness-tested at 91% efficiency at the C. H. Wheeler Test Laboratory, operating against a head of 72 feet at 880 RPM) can pump as much as 80,000,000 gallons of water a day. With automatic "Push-Button" regularity these four C. H. Wheeler Pumps replenish two steel tanks with the wash water required to clean the 94 rapid sand filter beds. Surface wash water for the filter beds is supplied by three additional C. H. Wheeler 6″ x 5″ Double Suction Pumps, each with a capacity of 1,500,000 gallons a day, operating against a head of 210 feet, 1760 RPM.

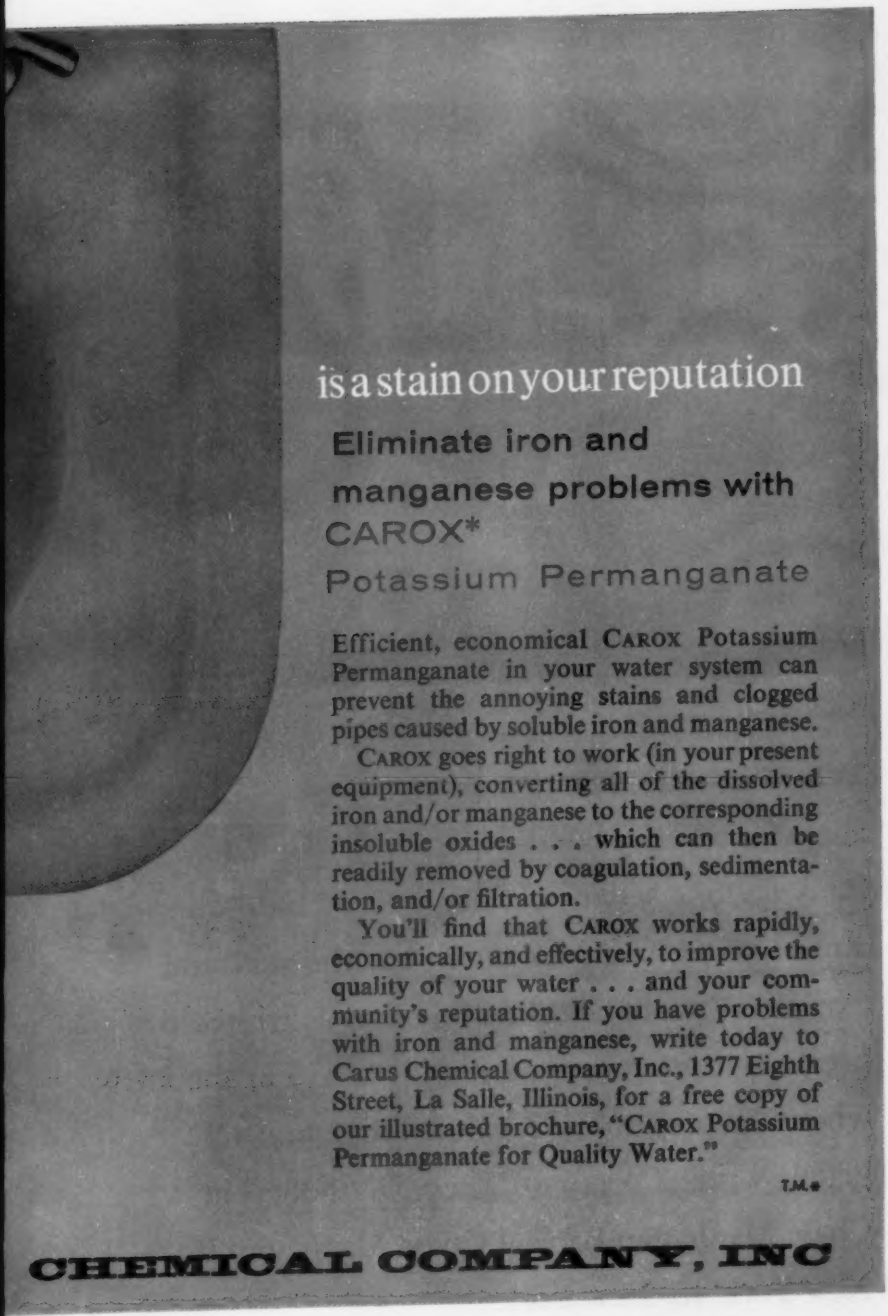
Whatever your pump problem, talk to your C. H. Wheeler representative —he has your answer.

C.H. WHEELER / GRISCOM-RUSSELL

Philadelphia 32, Pa. Massillon, Ohio

Affiliated sources for heat exchangers, steam condensers, pumps, marine auxiliary equipment, sea water distillation plants, nuclear steam generators and related components.


the
stain
on
the
bathroom
sink
CARUS


is a stain on your reputation
Eliminate iron and
manganese problems with
CAROX*
Potassium Permanganate
Efficient, economical CAROX Potassium Permanganate in your water system can prevent the annoying stains and clogged pipes caused by soluble iron and manganese.
CAROX goes right to work (in your present equipment), converting all of the dissolved iron and/or manganese to the corresponding insoluble oxides . . . which can then be readily removed by coagulation, sedimentation, and/or filtration.
You'll find that CAROX works rapidly, economically, and effectively, to improve the quality of your water . . . and your community's reputation. If you have problems with iron and manganese, write today to Carus Chemical Company, Inc., 1377 Eighth Street, La Salle, Illinois, for a free copy of our illustrated brochure, "CAROX Potassium Permanganate for Quality Water."
T.M.
CHEMICAL COMPANY, INC

on
the
bathroom
sink

CARUS

Efficient, economical CAROX Potassium Permanganate in your water system can prevent the annoying stains and clogged pipes caused by soluble iron and manganese.

CAROX goes right to work (in your present equipment), converting all of the dissolved iron and/or manganese to the corresponding insoluble oxides . . . which can then be readily removed by coagulation, sedimentation, and/or filtration.

You'll find that CAROX works rapidly, economically, and effectively, to improve the quality of your water . . . and your community's reputation. If you have problems with iron and manganese, write today to Carus Chemical Company, Inc., 1377 Eighth Street, La Salle, Illinois, for a free copy of our illustrated brochure, "CAROX Potassium Permanganate for Quality Water."

T.M.®

CHEMICAL COMPANY, INC

BLOOMINGTON ALL-AMERICA CITY

THOMAS L. LEMON
Mayor

CITY OF BLOOMINGTON
WATER DEPARTMENT
LESTER THORNTON, SUPT.

NOW SAVES OVER $30,000.00 ANNUALLY

IN TREATING 6,000,000 GALLONS* OF WATER DAILY WITH . . . . . Mogul Claracel!

The City of Bloomington operates two water clarification and filtration systems. One is a settling basin system, the other a clarifier system. Each system treats approximately 3,000,000 gallons of influent water per day. Solids carry-over was a consistent and continuing problem . . . especially during the spring rain season it affected the quality of the delivered water, the efficiency of the systems and the length of filter runs.

MODEL DAM BY R. S. BALDWIN

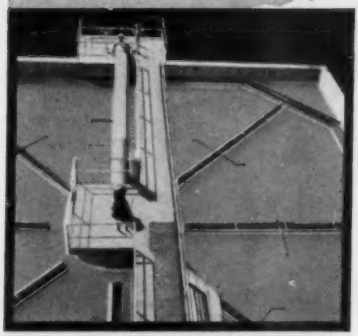
When it comes time to appoint a trustee or fiscal agent for revenue bonds, The Chase Manhattan Bank is at the service of state, county and municipal authorities. Chase Manhattan has the staff and experience to handle this function as trustee or fiscal agent in cooperation with banks in the areas where the projects are located. For complete details write: Corporate Trust Division, The Chase Manhattan Bank, 1 Chase Manhattan Plaza, New York 15, New York.

THOMAS L. LEMON
Mayor

CITY OF BLOOMINGTON
WATER DEPARTMENT
LESTER THORNTON, SUPT.

NOW SAVES OVER $30,000.00 ANNUALLY

IN TREATING 6,000,000 GALLONS OF WATER DAILY WITH . . . . . *Mogul Claracel!



The City of Bloomington operates two water clarification and filtration systems. One is a settling basin system, the other a clarifier system. Each system treats approximately 3,000,000 gallons of influent water per day. Solids carry-over was a consistent and continuing problem . . . especially during the spring rain season it affected the quality of the delivered water, the efficiency of the systems and the length of filter runs.

The addition of MOGUL CLARACEL showed the following results:

* Better and larger floc formation
* Substantial reduction in solids carry-over
* Filter runs increased from 12 to 24 hours
* Less water required for filter backwash
* Better filtration — "packing" of filters eliminated
* Cleaning of filters now done more easily in less time
* Delivered water of highest quality

THOMAS L. LEMON
Mayor

LESTER THORNTON
Supt. of Water Dept.

IRWIN L. DICKSTEIN
Chief Chemist

The improvement was so outstanding with Mogul Claracel that the water treatment results and savings have been endorsed by the city officials illustrated.

*A NEW SERIES OF COAGULANT AIDS

here are the savings

COST PER DAY	SETTLING BASIN SYSTEM BEFORE MOGUL CLARACEL	SETTLING BASIN SYSTEM AFTER MOGUL CLARACEL	SETTLING BASIN SYSTEM DAILY SAVINGS	CLARIFIER SYSTEM BEFORE MOGUL CLARACEL	CLARIFIER SYSTEM AFTER MOGUL CLARACEL	CLARIFIER SYSTEM DAILY SAVINGS
Alum	$73.20	$36.60	$36.60	$122.00	$61.00	$61.00
Lime	30.00	25.50	4.50	11.25	7.50	3.75

Treatment Savings Per Day	$105.85
Less Cost of Mogul Claracel	13.00
Net Savings Per Day	$ 92.85
Annual Savings	$33,890.25

The North American
MOGUL
Products Company
STANDARD BUILDING • CLEVELAND 13, OHIO

6,600 reasons why Greensburg depends on

Bailey!

Every day the 6,600 residents of Greensburg, Indiana, use up to 1,000,000 gallons of water. Three Bailey Filter Operating Consoles control and indicate the flow of this water through the rapid sand filters. Space for a fourth console has been provided for future expansion.

Engineers: Moore & Heger

With population growth and industrial expansion comes the opportunity to adopt newer, more economical and more scientific methods of water handling.

Many cities, like Greensburg, are installing Bailey Instrument and Control Systems. Because Bailey can furnish *complete* control systems . . . made up of *standardized* components . . . that not only do a better job, but can easily be *expanded* to meet future needs.

Engineers, water superintendents and city officials themselves will tell you that Bailey electric and pneumatic telemetering and control systems are outstandingly reliable and economical, attractive, and easy to maintain.

Ask your qualified Bailey Engineer for recommendations. W-5.5

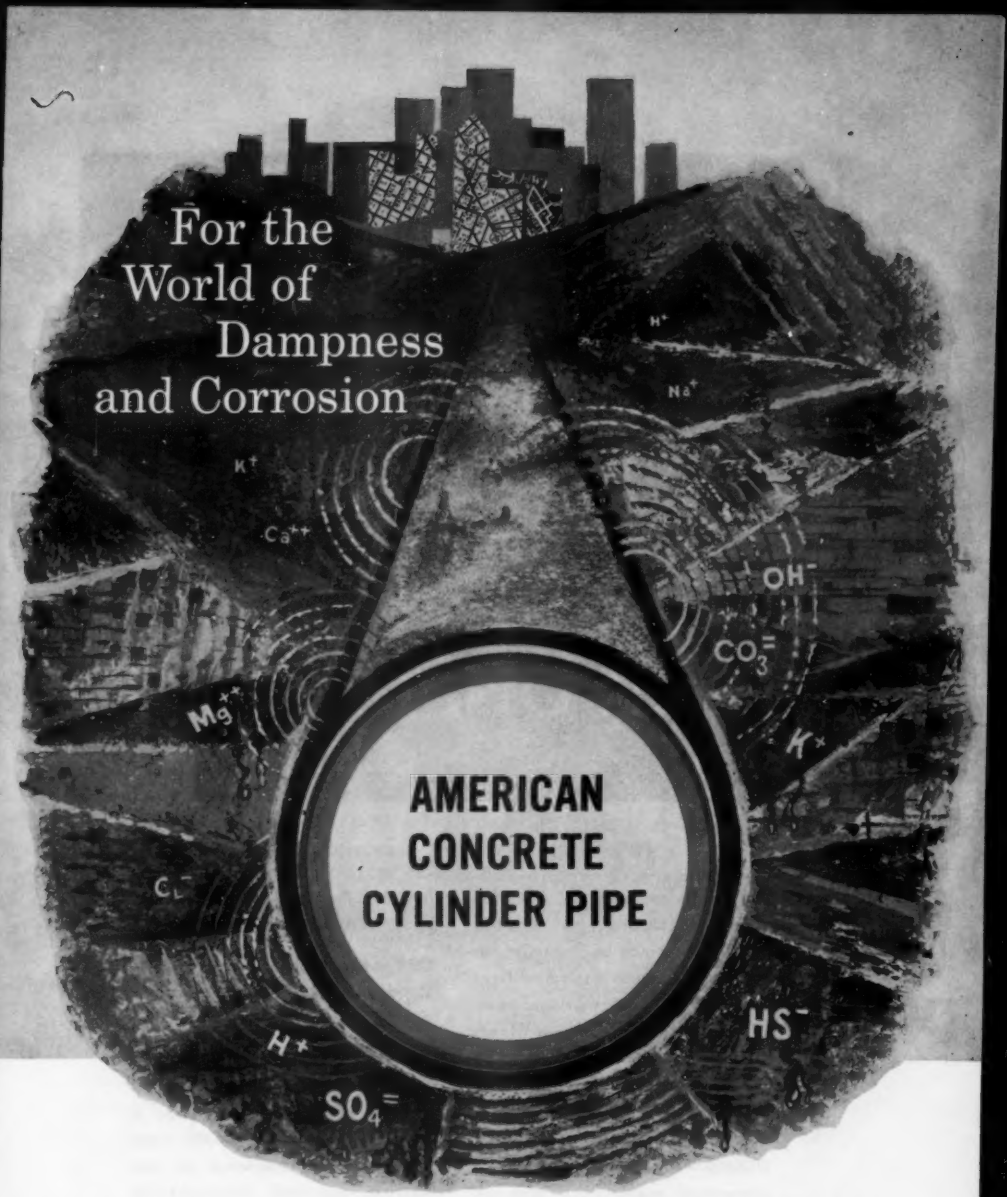
WATER & WASTE TREATMENT DIVISION

BAILEY METER COMPANY

1024 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada — Bailey Meter Company Limited, Montreal

BAILEY METERS



In the world of dampness and corrosion the most reliable material for permanent water supply and transmission lines is ageless concrete, working together with steel in a properly engineered composite structure. Concrete grows stronger with age, effectively resists soil stresses, and protects steel from electrolytic action and corrosion. American Concrete Cylinder Pipe is designed to obtain maximum advantage of the strength of steel and the protective characteristics and permanence of concrete. Properly installed, an American Concrete Cylinder Pipeline will retain its high flow capacity indefinitely without maintenance. Investigate the immediate and long-term economies of this superior quality pipe.

AMERICAN
PIPE AND CONSTRUCTION CO.

American Pipe and Construction Co. • Los Angeles • San Diego • Hayward • Portland
Bogota, Colombia ■ American Concrete Pipe Co. (subsidiary) • Phoenix • Albuquerque
Write P.O. Box 3428, Terminal Annex, Los Angeles 54, California
A MEMBER OF THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Pure filtered water...
YOUR
RESPONSIBILITY

Quality controlled alum...
OUR
RESPONSIBILITY

You can order Cyanamid Alum for your filtration processes with the utmost confidence because Cyanamid Alum is quality controlled from start to finish to meet stringent specifications. Manufacturing plants are strategically located to give efficient service throughout the country.

Supplied in the form you want

LIQUID — for cleaner, easier, more economical operation. In tank wagons and tank cars from 9 convenient shipping points. Conforms fully to AWWA standards.

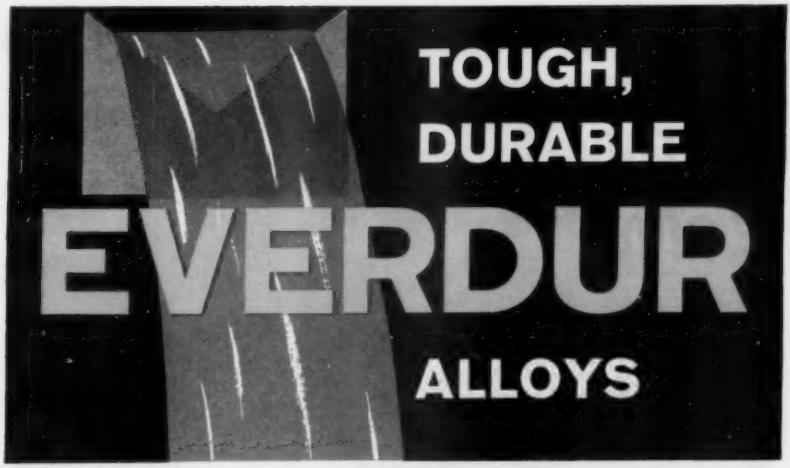
DRY — conforms fully to AWWA standards in ground, rice, lump or powdered grades. Bagged or bulk.

THINKING OF CONVERTING TO LIQUID? Your costs—and savings—can be determined quickly by a Cyanamid representative with years of conversion experience at your service. Just call Cyanamid for product or technical service.

ALUM CYANAMID

AMERICAN CYANAMID COMPANY

Process Chemicals Department, 30 Rockefeller Plaza, New York 20, N. Y.
In Canada: Cyanamid of Canada Limited, Montreal and Toronto



highly resistant to wear and abrasion in sewage and water works systems

EVERDUR® copper-silicon alloys have excellent resistance to corrosion in all types of water works installations and at all stages of sewage treatment operations. EVERDUR equipment in the United States has been in service *without replacement* for 30 years and longer.

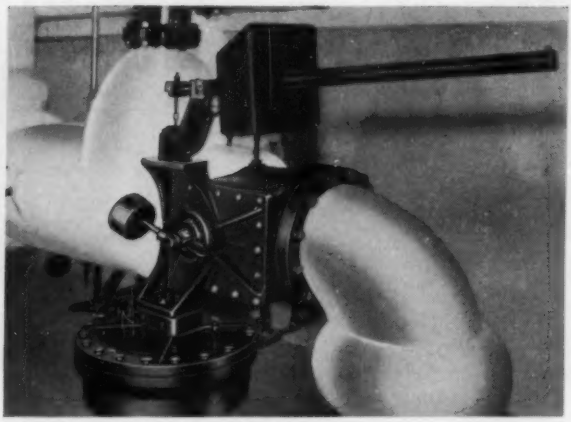
Easily fabricated EVERDUR provides high physical strength with lighter weight. It is used extensively in sewage systems handling corrosive wastes in screens, stems, manhole steps, guides, bolts, weirs, float chambers, troughs. And for water works equipment you will find EVERDUR alloys in long service as surface reservoir outlet screens and screen frames and as large diameter cylindrical well screens in drilled well supply systems. Other uses: spillway fittings, guides, seats and sealing strips. And don't forget EVERDUR Electrical Conduit for use in corrosive atmospheres.

Publication E-11 shows typical applications and other data. Write for your copy—or for assistance from our Metallurgical Dept. in selecting the proper corrosion-resistant alloys for your equipment. Address: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Canada. 61-811

EVERDUR®
a product of
ANACONDA®
AMERICAN BRASS COMPANY

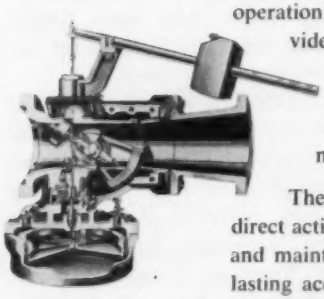
FIRST . . . IN MEASUREMENT AND CONTROL OF MATERIALS FLOW

TOO GOOD TO CHANGE



B-I-F FLOW-RATE CONTROLLERS WORK BETTER, COST LESS!

Eliminate expensive secondary controls and accessories! Don't let electrical power or air supply failures stop your operation! This rugged, life-of-bond rate controller provides positive control and measurement of effluent flows. So well conceived was the original design that many units have operated continuously for over thirty years . . . with optimum results . . . without breakdowns!



There is no better way to do the job! Model RCE direct acting Rate-of-Flow Controllers cost less to install and maintain . . . permit flexible piping layouts . . . have lasting accuracy (within ±3% over a control range of 25% to 100% of maximum capacity), and are available in 3" to 24" standard pipe sizes.

B-I-F Industries

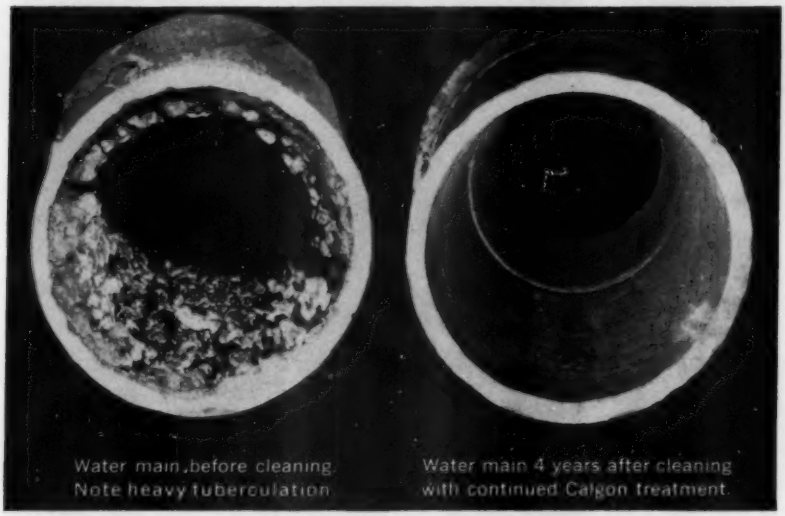
A DIVISION OF THE NEW YORK AIR BRAKE COMPANY

METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

Request Bulletin 600-G6B for complete details. Write **B-I-F Industries, 365 Harris Ave., Providence 1, Rhode Island.**

CALGON KEEPS FLOW RATES CONSTANT AFTER MAIN CLEANING

in 4-Year Portland Water District Test



Water main before cleaning. Note heavy tuberculation.

Water main 4 years after cleaning with continued Calgon treatment.

Part of the Portland, Maine, Water District System supplies Sebago Lake water to Gorham Village. An 11,000-foot, 8-inch main was the main feed between a booster station and a standpipe at the far end. This main had not been cleaned for 20 years, and it was found that the flow coefficient "C" had dropped to between 50 and 56 due to massive tuberculation.

Replacement or reinforcement of this main would be expensive, so it was decided to try cleaning a 4,000-foot section of the main, and use this as a test section to determine the effectiveness of chemical treatment to retard corrosion. Calgon® and Calgon® Composition TG were chosen for this test.

HERE ARE THE RESULTS:

Pipe line coefficient, raised from 56 to 120 by cleaning, *has remained at this level for four years with Calgon and Composition TG treatment.*

No red water complaints.

Labor and chemical costs, in relation to replacement or reinforcement of the main, *have been minor.*

A complete description of this carefully controlled test, with prescribed dosages and methods, is available—ask for Reprint No. 420-12-6. For information on how Calgon chemicals and Calgon know-how can help you, contact:

CALGON COMPANY
HAGAN CENTER, PITTSBURGH 30, PA.

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

Chicago Bridge & Iron Company

Write our nearest office for complete information or estimating figures on steel tanks for municipal service.

Offices

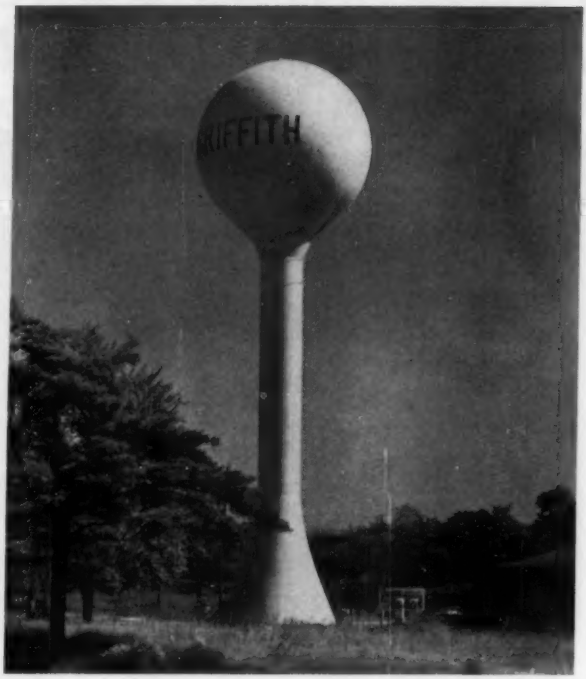
Atlanta
Birmingham
Boston
Chicago
Cleveland
Detroit
Houston
Kansas City, Mo.
New Orleans
New York
Philadelphia
Pittsburgh
Salt Lake City
San Francisco
Seattle
South Pasadena
Tulsa

Plants

Birmingham
Chicago
Greenville, Pa.
Houston, Texas
New Castle, Del.
Salt Lake City

IN CANADA:

Horton Steel Works Limited



Landmark of Progress

Indiana's growing community of Griffith once was plagued by an annual shortage of water during the summer months—but not any more. Griffith's citizens now have plenty of water for general use and fire protection.

A 200,000-gallon Horton Watersphere—rising 98 feet to bottom—is symbolic of the community's enlarged and modernized water distribution system. Other improvements include a 1,000,000-gallon CB&I-built ground reservoir and a 4,000,000 gallon-per-day pumping station.

If your community's water pressures sag during peak-use periods, write today for the new CB&I bulletin: The Watersphere and Waterspheroid.

These Comparisons Show Why CAST IRON PRESSURE PIPE is America's No. 1 Tax Saver

POINTS TO COMPARE	CAST IRON PIPE	NON-FERROUS PIPE
Long Life	100 Years or more	?
Bursting Pressure	2,988 psi	746 psi
Bursting Tensile	25,880 psi	3,430 psi
Impact Resistance	234 ft. lbs.	60 ft. lbs.
Beam Loads (12-foot span)	20,790 pounds	3,060 pounds
Crushing Loads	17,900 lbs. per ft.	6,480 lbs. per ft.
Water Absorption	None	9.8% of weight after 24-hour submersion
Tight Joints	Wide selection for liquid or gas service	Limited selection for liquid service
Inside Diameter	6.14"	5.85"

Pipe tested were 6" Class 150.

—and also why CAST IRON PRESSURE PIPE actually COSTS LESS

This advertisement published in the interests of the Cast Iron Pressure Pipe Industry by

WOODWARD IRON COMPANY
Since 1882
WOODWARD, ALABAMA

NON-STOP FILTERING

even when backwashing GFC Multi-Cell Filters

There's no time lost when backwashing GFC Multi-Cell Filters. While one cell is being backwashed, the other cells provide: **(a)** Water for backwashing that cell **with or without** the use of storage tanks or surface reservoirs. **(b)** Uninterrupted filtering to maintain a continuous flow to service lines. Other important features include low-cost installation and GFC's patented non-clogging "Multi-Plate" underdrains. Write for bulletins and equipment data.

GENERAL FILTER CO.

WATER PROCESS EQUIPMENT AMES, IOWA

AERATORS • FILTERS • SOFTENERS • CLARIFIERS
FLASH MIXERS • FLOCCULATORS • PNEUMATIC CONTROLS
ROTARY DISTRIBUTORS • SLUDGE SCRAPERS

BONDED
WATER TANK MAINTENANCE

★ ★ ★ ★

TANK MAINTENANCE AND REPAIR WORK IS GOOD ONLY IF

It is done by a contractor with

——EXPERIENCE ——INTEGRITY

——TRAINED MANPOWER

Our 25 year record is

——Over 7000 jobs completed

——Over $5,000,000.00 of work completed

Tank work is hazardous—14 men died while performing this work in the last 12 months.

We pioneered for the industry, the annual bonded maintenance for owners of water storage facilities.

Performance guaranteed by a nationally known Surety Company.

OFFERED ONLY BY
NATIONAL TANK MAINTENANCE CORPORATION
UPPO 1006
1617 Crocker St.
Des Moines, Iowa
CHerry 3-8694

Write, Telephone, or Wire Collect

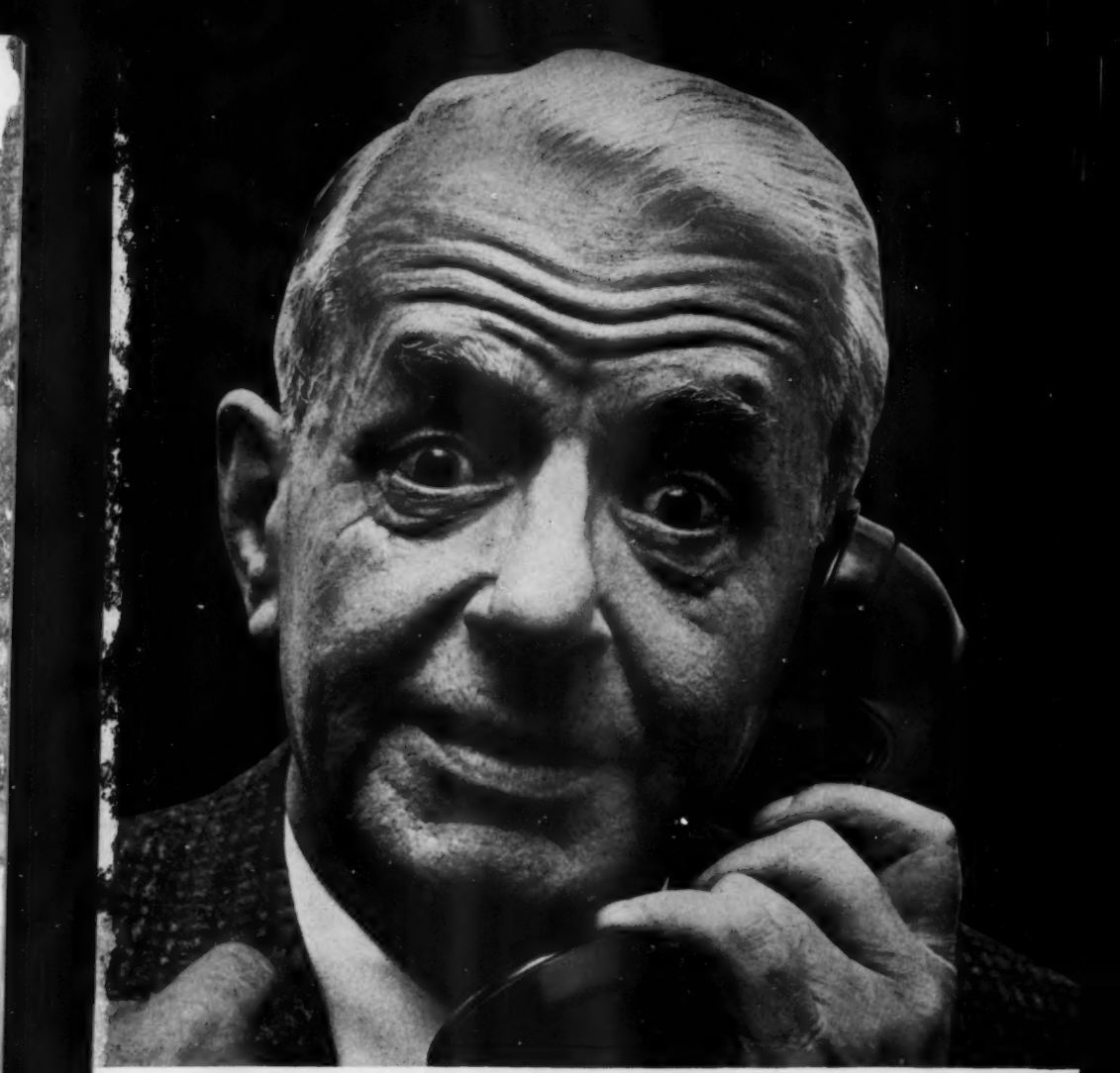
"Every Job a Reference"

Protection, clear to the city.

Dry HTH hypochlorite helps keep water sanitary, *right* from the reservoir to the drinking glass. Around watersheds, in pipelines, in new wells . . . HTH releases effective, dependable chlorine to kill bacteria, algae and fungi fast. Comes in pails, drums and new plastic bottles. Write for literature. Olin Mathieson, Baltimore 3, Maryland.

Here's to Health . . . **HTH®**

CHEMICALS DIVISION Olin



"He's calling me the idiot!"

"Of all the nerve! I oughta remind His Honor that *he* hired the guy who wrote up the pump specs. No experience clause . . . and who's low bidder? Some outfit that builds *bilge pumps!* The Mayor should hear those things howl and vibrate! Sure they meet rated capacity, but all the bearings are so hot it smells like we're barbecuing grease! Next time I'll make darn sure we get that experience clause *in*."

Comprehensive *experience* in pumps — an important benefit that's yours when you deal with Allis-Chalmers. Industrial Equipment Division, **Allis-Chalmers,** Milwaukee 1, Wisconsin.

ALLIS-CHALMERS — 93 YEARS OF PUMP EXPERIENCE

Allis-Chalmers has a pump-building history going back over 90 years. In 1888, we developed the largest centrifugal pumps of that time . . . and they are still operating. Through a program of sound, gradual development, Allis-Chalmers pump designs are improved regularly with tested ideas . . . no idea goes into production for our customers until it has been proved sound in tests.

A-1512

Photographs, factual data, and quotations courtesy of Water Department, Wilmington, Delaware; W. Compton Wills, Manager and Chief Engineer.

Bare steel pipe, installed in 1907-1908, is still serving Wilmington, Delaware

These photographs were taken in 1907, the year Wilmington began installing two major steel pipelines, totalling 20,340 ft. Even though this pipe was put in *bare*, it is reported by the Water Department to be "in satisfactory condition for use over the next 15 to 20 years or longer."

Nowadays we recommend installing steel pipe with AWWA-approved coal-tar enamel, assuring incomparable protection from attack, and sustained carrying capacity. If Wilmington's bare pipe can serve for more than a half-century, what is the reasonable service life of properly protected steel pipe? One hundred years? More?

Long service life, high flow capacity, tight joints, freedom from the failures of brittle materials—those are the advantages of coal-tar-enameled steel pipe. For additional facts, just get in touch with the Bethlehem sales office nearest you.

Wilmington's water system includes 12,000 ft of 48-in., and 8,000 ft of 43-in. lockbar steel pipe.

Steel *for Strength ... Economy ... Versatility*

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

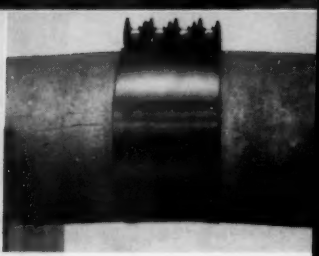
BETHLEHEM STEEL

Now... pipe repairs are easier than ever

with the Dresser® 360® Clamp!

Dresser "360" repairs steel, cast iron or A-C pipe. One-side wrenching lets bolts be tightened from easiest position.

Drop-in bolts mean fast, easy assembly, no loose parts. Simply spring clamp around pipe, drop in bolt heads and tighten nuts.



The "360" holds pipe bottle-tight, even when deflected as much as 5°. Also, it is not troubled by misalignment up to 1/8".

Nothing beats the speed and ease of repairs with the Dresser "360" All-Around Repair Clamp! With its drop-in bolts, there's no nut removal, no loose parts in the ditch...one set of lugs means bolting where it's easy. The gasket—a thick, smooth, butt-joined blanket has 65% more rubber for absolute sealing. Doesn't wrinkle. The Dresser "360" provides 3/8" adjustment—fits more pipe sizes, means fewer clamps to stock. For details on the "360", or any of THE DRESSER LINE for coupling or repairing pipe — write us, or call your nearest Dresser Distributor.

dmd

DRESSER

MANUFACTURING DIVISION
BRADFORD, PENNSYLVANIA

DRESSER INDUSTRIES, INC.

OIL ▪ GAS
CHEMICAL
ELECTRONIC
INDUSTRIAL

PIPE THAT SHOULDERS A HEAVY LOAD WITHOUT SHOWING ITS AGE

Recently installed in a town in Illinois, this cast iron pipe water supply system now serves a large industrial area.

Besides the internal pressure of supplying the heavy daily demand, there is a heavy load overhead, too. The industrial area is a packaging and distribution center. Large numbers of fully loaded rail cars and trucks come and go every day.

As far as the cast iron pipe is concerned, this is all in a day's work.

Cast iron pipe shoulders heavy loads —interior and exterior—year after year; performs efficiently for a century or more.

And it always delivers a full flow of water.

ADVERTISING CAMPAIGN FROM CAST IRON PIPE RESEARCH ASSOCIATION SHOULDERS A HEAVY LOAD, TOO!

For years the Cast Iron Pipe Research Association has attacked the water problem nationally; now, in addition, it is undertaking a new campaign to combat this crisis on a local level. Car cards, speeches, radio spots, newspaper ads, mailing pieces—everything will be included. If your town's problem is apathy or a growing water shortage, we may be able to help. For complete details, write to the Cast Iron Pipe Research Association today!

CAST IRON PIPE RESEARCH ASSOCIATION
Thos. F. Wolfe, Managing Director
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE

"Only The Best"

For ordering dependable and proven pipe line equipment, consult your latest Pollard Catalog #27.

Included in the #27 Catalog, and displayed on this page, are the M-Scope Transistorized Combination Leak Detector and Pipe Locator, Audio-Scope, Geophone Leak Detectors, T-10 Electronic Box Locator, Aqua Valve Box Locator and Magnetic Dipping Needles for locating service boxes.

Hundreds of water departments all over the country are using Pollard "one order" service. You, too, can enjoy the advantages of ordering from the nation's #1 source for dependable pipe line equipment.

PIPE LINE EQUIPMENT
JOSEPH G. POLLARD CO., INC.
PIPE LINE EQUIPMENT
PIPE LINE EQUIPMENT

Place your next order with POLLARD

NEW HYDE PARK • NEW YORK

Branch Offices: 964 Peoples Gas Building, Chicago, Illinois
333 Candler Building, Atlanta, Georgia

PHONE: PIONEER 6-0842

Journal
AMERICAN WATER WORKS ASSOCIATION
VOL. 53 • OCTOBER 1961 • NO. 10

Water Use in the United States, 1960

Kenneth A. MacKichan

A paper presented on Jun. 8, 1961, at the Annual Conference, Detroit, Mich., by Kenneth A. MacKichan, Hydraulic Engr., USGS, Ocala, Fla.

THE use of water as a natural resource generally reduces the quantity available and frequently causes its quality to deteriorate. Quality may be adversely affected by addition or concentration of mineral constituents or by addition of bacteria, organic matter, or heat. Because the use of water affects it as a resource, an adequate evaluation of water resources in the United States requires a knowledge of the quantity of water used, where it is used, and how it is used.

USGS has just completed an estimate of the water used during 1960 as part of its responsibility for evaluation of United States water resources. The current estimate is similar to estimates for 1950 and 1955,[1] except that the amount of water consumed or evaporated, as well as the amount of water withdrawn, was estimated for the current survey. Estimates were made for: public supplies, irrigation, rural use other than irrigation, and self-supplied industrial use.

Local offices of the USGS Water Resources Division supplied estimates of water used in their territories. The many, widely scattered offices of the Water Resources Division (at least one office in 48 of the 50 states) made such a survey possible.

Definition of Terms

Uses of water may be classified in several different ways. Among them are withdrawal and nonwithdrawal use, and consumptive and nonconsumptive use. Withdrawal use is the quantity of water removed from the ground or diverted from a body of surface water. Consumptive use is the portion of water used that is discharged to the atmosphere or incorporated in growing vegetation or in industrial or food products.[2]

Saline water is defined as water containing more than 1,000 ppm of dissolved solids regardless of the composition of the solids.

Amount Used

The withdrawal use of water in the United States during 1960 was almost 270,000 mgd (1,500 gpcd), exclusive of water used to generate hydroelectric power. The quantities of water used are given in Table 1 for each of the 24 regions shown in Fig. 2 and 3. Only 23 per cent of the water withdrawn, or 61,000 mgd, was consumed. This consumptive use amounts to about 340 gpcd.

Figure 1 shows how water was used in 1960. Self-supplied industry withdrew the largest quantity, 140,000 mgd of the total 270,000 mgd. Irrigators withdrew the second largest quantity, 110,000 mgd (this includes conveyance losses). Public supplies withdrew 21,000 mgd, and self-supplied rural users withdrew the smallest amount, 3,600 mgd. The consumption pattern is entirely different. Irrigators consumed the largest quantity of water, 52,000 mgd of the total consumption of 61,000 mgd. Public supplies consumed the second largest quantity, 3,500 mgd. Self-supplied industry consumed 3,200 mgd, and self-supplied rural users consumed 2,800 mgd.

TABLE 1

*Water Used in the United States, 1960**

Region	Water Withdrawn (Fresh and Saline)—*mgd*				Saline Water Withdrawn† *mgd*	Water Consumed *mgd*
	Ground Water	Surface Water	Waste Water	All Water		
New England	350	6,000	0	6,400	3,400	290
Delaware-Hudson	1,200	18,000	0	20,000	9,000	830
Chesapeake	480	6,600	70	7,100	1,900	320
South Atlantic	2,000	11,000	0	13,000	3,800	1,500
Eastern Gulf	700	5,200	0	5,900	880	510
Tennessee-Cumberland	370	7,200	0	7,500	0	400
Ohio	1,300	22,000	0	24,000	0.3	800
Eastern Great Lakes-St. Lawrence	340	12,000	0	13,000	0	420
Western Great Lakes	830	16,000	0	16,000	0	510
Hudson Bay	50	130	0	180	0	54
Upper Mississippi	1,300	10,000	0	11,000	0	570
Upper Missouri	2,800	17,000	0	20,000	5.0	7,400
Lower Missouri	180	1,400	0	1,600	0	200
Lower Mississippi	1,400	3,900	0	5,300	1,600	1,300
Upper Arkansas-Red	2,100	3,400	0	5,500	120	3,200
Lower Arkansas-Red-White	960	4,000	0	4,900	4.0	850
Western Gulf	11,000	11,000	0	22,000	1,400	9,200
Colorado	3,500	11,000	0.2	14,000	0	7,100
Great Basin	910	6,100	0	7,000	5.5	3,300
South Pacific	10,000	23,000	0.5	33,000	9,100	13,000
Pacific Northwest	3,700	25,000	0	29,000	48	8,300
Hawaii	600	970	0	1,600	280	410
Alaska	25	180	0	200	0	0.7
Puerto Rico	210	1,000	0	1,200	650	280
Total	47,000	220,000	71	270,000	32,000	61,000

* Values shown are round figures made individually from complete figures and sums.
† As used for all purposes except public supplies.

Pattern of Use

Climate has a very pronounced effect on the water use pattern. Consumption rates are higher in a warm, dry climate, as in the semiarid parts of the United States. The available supply is generally low; therefore users are likely to conserve their water supply by recirculation, or by using saline or other waste water. Irrigation, the largest use of water in the western states, is highly consumptive. Figure 2 shows where irrigation water is used. More than 90 per cent is used in the seventeen western states, and about 66 per cent of the water applied to the land is consumed.

The pattern of industrial use is just the reverse; 85 per cent of the industrial water is used in the East (Fig. 3). About 94 per cent of all industrial water is for cooling, with only a slight consumptive use; only about 2 per cent of this water is consumed.

Because the highly consumptive irrigation use predominates in the West and the almost nonconsumptive industrial use predominates in the East, 80 per cent of the water consumed is consumed in the West (Fig. 4). The West has only about 25 per cent of the United States water supply; the greatest depletion occurs where it can least be afforded.

Of the 21,000 mgd withdrawn for public supplies, only 7,000 mgd was withdrawn in the seventeen western states. The per capita rate, however, was much higher in the western states, 190 gpcd as compared to 138 in the remaining states. Twenty-three per cent of the water withdrawn in the West was consumed, but only 14 per cent of the water withdrawn in the remaining states was consumed. Therefore, consumption—water lost by evaporation in the course of use—was more than twice as great in the West, 43 gpcd as compared to 19 gpcd in the East. The greater per capita rates of withdrawal and consumption in the western states are caused by the use of large quantities of water for watering lawns and gardens. Industry and commerce draw from public supplies at about the same per capita rate in the West as in the East.

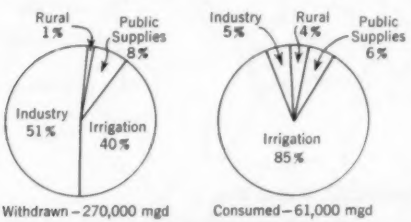


Fig. 1. Uses of United States Water

The different uses of water withdrawn and water consumed are illustrated.

TABLE 2

Change in Withdrawals

Use	1950	1955	1960
Rural	3,600	3,600	3,600
Public supplies	14,000	17,000	21,000
Self-supplied industrial	77,000	110,000	140,000
Irrigation (excluding conveyance losses)	79,000	81,000	84,000
Irrigation (including conveyance losses)		110,000	110,000
All uses (excluding conveyance losses)	170,000	210,000	250,000
All uses (including conveyance losses)		240,000	270,000

Availability of water also influences the user's choice of supply. Practically all the sewage or other waste water used for irrigation was used in the seventeen western states. The water user in a dry area is more likely to select ground water than surface water. Forty-four per cent of all water withdrawn for public supplies and 36 per cent withdrawn for self-supplied industry (except electric power) was taken from wells or springs in the western states, whereas only 24 per cent and 14 per cent, respectively, was

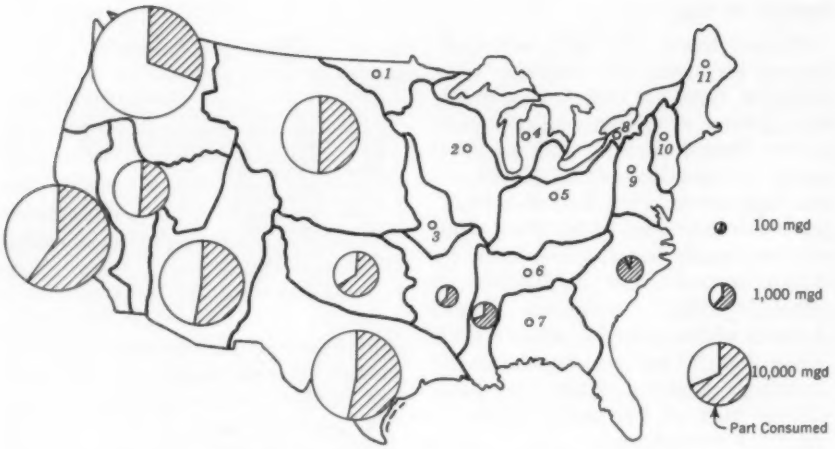


Fig. 2. Locations of Irrigation Water Use

In regions with small circles and labeled 2, 3, 4, 5, 6, 7, 8, 9, and 10, all water was consumed. In region labeled 1, about 50 per cent was consumed; in region 11, 72 per cent was consumed.

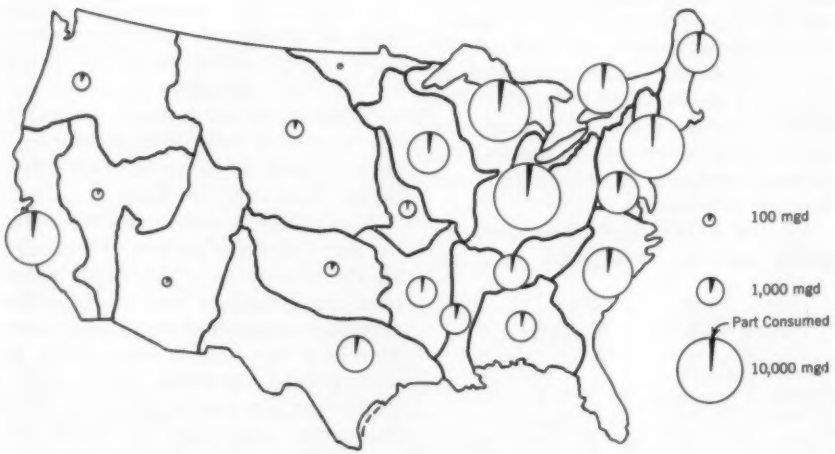


Fig. 3. Locations of Industrial Water Use

Proportion consumed of water withdrawn for industrial purposes is lower than that of water withdrawn for irrigation.

withdrawn from wells and springs in the remaining states.

Use and Supply

Many popular and technical writers claim erroneously that the United States is running out of water. In many places users may not have all the high-quality water they need at the price they would like to pay, and in a few places they may never have enough. The United States is not running out of water, however, nationwide or even in large river basins.

Meaningful comparisons of use and supply are difficult to make because the supply is not simple to evaluate and the conditions of comparison must be described in detail or the comparison may be misinterpreted. Supply must be compared with *consumptive use*. Most writers make the mistake of comparing supply with *withdrawals*.

The dependable supply is not a fixed amount, but can be increased by surface storage, artificial recharge of ground water, and reducing evaporation losses or other forms of waste. These measures increase the cost of water, so the increase in dependable supply depends on the ability of the user to pay the higher cost.

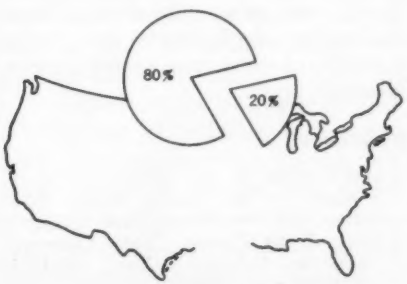


Fig. 4. Eastern and Western Consumption of Water

Consumption by irrigation accounts for larger consumption in the West.

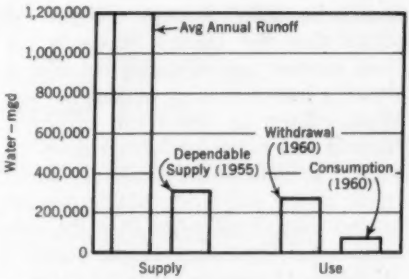


Fig. 5. Water Supply and Demand in the United States

Withdrawal for 1960 approaches supply for 1955, but consumption is lower than withdrawal, and supply is lower than average annual runoff.

The average annual runoff can be used as a measure of the supply, or the supply can be estimated taking into account the relative cost of developing each increment of supply and the user's ability to pay. The former is fairly fixed and can be duplicated by various estimators, whereas the latter depends on the personal judgment of the estimator.

Runoff is the upper limit of the water supply and is the total flow of the streams including outflow from ground-water storage through springs and seeps, as well as the overland flow that follows hard rains. The runoff of all streams in the United States (excluding Alaska and Hawaii) averages 1,200,000 mgd. A substantial part of the runoff cannot be used because it occurs as floods flowing in such large volumes that it cannot be stored economically. Furthermore, if flood waters are held in storage for long periods, evaporation takes a heavy toll, thus reducing the supply available.

Woodward [3] estimated that the dependable supply that could be developed at 1955 prices for water was 314,000 mgd. He estimated that by 1980 the probable dependable supply

would be 597,000 mgd. Figure 5 shows that the United States is far from running out of water, but Fig. 6 shows a less promising outlook for the West. Even in the West, however, there is still room for further development. Present withdrawals are about equal to the 1955 dependable supply, but are considerably less than the ultimate supply (average annual runoff). Woodward [3] estimates that the dependable supply will be almost 200,000 mgd, or 60 per cent greater, by 1980. Present withdrawals are 120,000 mgd. Consumptive use is much less, 52,000 mgd.

Trends

Comparison of the current survey with previous surveys shows some very interesting trends. Over the United States there has been a 12 per cent increase in water withdrawn for use in the four main categories since 1955 (Fig. 7). During the same period withdrawals increased by 50 gpcd. The greatest sector of withdrawal increase during the last 5 years, 27 per cent, was in self-supplied industrial water (Table 2). The use of saline water almost doubled between 1955 and 1960.

Consumption was not estimated for the earlier surveys, but consumption

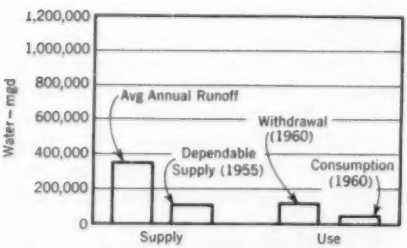


Fig. 6. Water Supply and Demand in the West

Present withdrawal nearly equals 1955 supply.

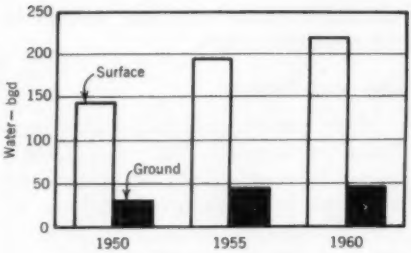


Fig. 7. Trends in Withdrawal

Water withdrawn has increased 12 per cent since 1955.

in each category has probably increased at about the same rate as withdrawals. Total consumption, however, has probably increased at a slightly lower rate than withdrawals because the largest increase has been in the relatively nonconsumptive industrial category.

Although the use of water continued to increase, the rate of increase is declining. Part of the decline is caused by the use of water-saving equipment. For example, many petroleum refineries in the Delaware River basin have recently installed cooling towers. As a result, water intake decreased but water consumed increased slightly. The recession of the economy has had a slight nationwide effect and a very noticeable effect in some areas. Withdrawal rates in other local areas have declined because industries using large quantities of water have moved to more favorable areas.

References

1. MacKichan, K. A. Estimated Use of Water in the United States, 1955. *Jour. AWWA*, 49:369 (Apr. 1957).
2. Task Group Report. Water Conservation in Industry. *Jour. AWWA*, 45:1249 (Dec. 1953).
3. Woodward, D. R. Availability of Water in the United States With Special Reference to Needs by 1980. Industrial College of the Armed Forces, Washington, D.C. (1957).

Bureau of Reclamation Work in the Colorado River Basin

Floyd E. Dominy

A paper presented on Jun. 7, 1961, at the Annual Conference, Detroit, Mich., by Floyd E. Dominy, Comr. of Reclamation, US Dept. of the Interior, Washington, D.C.

THE federal reclamation program first authorized by Congress in 1902 had as its primary objective the supplying of water for irrigation of the arid lands of the western states. This is still its primary mission, but reclamation officials have found that wherever arid land is placed under irrigation and made productive, a new population moves in, new communities spring up, and new economic opportunities are provided through the service trades, agricultural processing, mining, and manufacturing. This expansion automatically creates a new demand for water for domestic and industrial use. By now, water is becoming so scarce, and the competition for it so strong, that only by a multiple-use concept of water development can all the needs be met. Hence many municipalities and industrial users in the western states now look to the US Bureau of Reclamation multiple-use projects for water supply sources.

A representative example of this development of multiple water uses from a reclamation project is the Salt River project in Arizona, one of the lower Colorado River Basin states. The Salt River reclamation project was one of the first to be undertaken by the federal government, back in 1903.

That project encompasses most of Maricopa County, Ariz., the main city of which is Phoenix. Residents of Maricopa County know that their economy is predicated to a large degree on the Salt River project.

The Colorado River Basin

The Colorado River flows between Arizona and California into Mexico and the Gulf of California, but its headwaters are 1,400 mi upstream in the high mountain country of Colorado. It drains an area of 242,000 sq mi, 8 per cent of the area of the continental United States, and 2,000 sq mi in Mexico. The Salton Sea Basin, a drainage area in Southern California, includes the fertile Coachella (Fig. 1) and Imperial Valleys. It is outside the natural drainage basin of the Colorado River, but is dependent on the river for its entire water supply. The vast metropolitan area of Southern California also receives a major share of its water supply from the Colorado River through a 300-mi aqueduct.

The Colorado River Basin has a lower average rate of precipitation than any other river basin in the United States, except for a few closed basins without outlet to the sea. The annual precipitation, however, varies widely in different parts of the basin.

Along the Mexican border near its mouth, precipitation averages only about 2.5 in.; on the higher mountains of Colorado, Wyoming, and Utah, the average is around 40 in. The runoff of the river also varies greatly, not only from season to season, but from year to year. For example, the maximum yearly runoff at Lees Ferry, Ariz., which is the division point between the upper and lower basins, occurred in 1917 when 21,825,000 acre-ft of water was recorded. In 1934, the minimum flow of record was only 4,397,000 acre-ft.

The low average precipitation and the rugged terrain that characterize much of the Colorado River Basin account for the relatively slow economic development rate in the basin. The average population density in the basin is only about 10 per cent of the national average.

In this basin, agriculture and irrigation are almost synonymous. Successful crop production with reliance only upon rainfall is of negligible importance. Yet most irrigation developments are relatively costly and complex.

Fig. 1. Date Garden in Coachella Valley, Calif.

Irrigation water from the Colorado River makes agriculture in California's Salton Sea Basin possible.

With one or two notable exceptions, the larger irrigation undertakings have required participation of the federal government through the Bureau of Reclamation. Great strides have been

made in the half century of federal participation, but the job is still far from complete.

It is natural that irrigation in the Colorado River Basin began on the largest scale in the broad fertile valleys near the river's mouth in California and Arizona, where a year-round growing season prevails. It was a simple matter to divert the water from the rim of the Imperial Valley to irrigate lands on the valley floor, which is below sea level. As irrigation expanded, however, problems multiplied.

The Imperial Valley and Hoover Dam

In 1905, the Colorado, swollen by flood waters from the Gila, broke through a cut in its bank and for 16 months poured its entire flow into the Imperial Valley, causing millions of dollars in damage. By great effort, the break was repaired and the river returned to its regular course.

The Imperial Valley, which by 1922 had more than 400,000 acres under irrigation by direct diversion without storage regulation, suffered water shortages in low-water years that occur from time to time without pattern. Furthermore, each year the river was depositing more than 100,000 acre-ft of silt in the delta region, lifting itself higher and higher and making a larger and continuous expenditure necessary to maintain levees protecting the Imperial Valley. Vast sums were being spent to remove silt from the canal systems.

It was obvious that building a dam of unprecedented height and width, upstream in the deep gorges of the Colorado, would solve the problems of floods and drought. The reservoir would also retain the sediment that was so troublesome downstream. At the same time, the dam could provide hydroelectric power, municipal water, and recreational and other benefits.

Despite the many merits of such a project, it was opposed by upper-basin interests in Colorado, Utah, Wyoming, and New Mexico because it would endanger their future right to use the river. The mountainous watersheds of these states, they argued, contribute 90 per cent of all of the flow at the mouth of the Colorado River.

A large storage reservoir in the lower basin would permit full control and use of this water downstream. Under the western water doctrine of prior use that "first in time is first in right," later developments on the tributary streams in the upper basin might be precluded. These understandable but conflicting long-range plans for developing the economic potential of the river finally led to the Colorado River Compact of 1922. This compact apportioned the water of the river system between the upper and lower basins. Under the protection of the compact, the upper-basin interests withdrew objections and supported the authorization and construction of Hoover Dam and other developments in the lower basin. The wisdom of the federal government's $454,000,000 investment in these downstream structures is evident. Not only is the actual investment being returned to the US Treasury, but the whole Southern California-Nevada-Arizona complex has benefited economically with secondary national benefits of major importance.

Upper-Basin Compact

As a basis for formulating a coordinated plan for use of the remaining undeveloped water resources of the Colorado River system, the Bureau of Reclamation in 1946 issued a comprehensive inventory of development pos-

sibilities. The report outlined 134 potential developments, of which 100 were in the upper basin and 34 in the lower basin. Some of the projects outlined would divert water outside the Colorado Basin boundaries to adjacent areas. It was recognized that in neither the upper nor lower basin is sufficient water available for all of the potential projects outlined in the 1946 report.

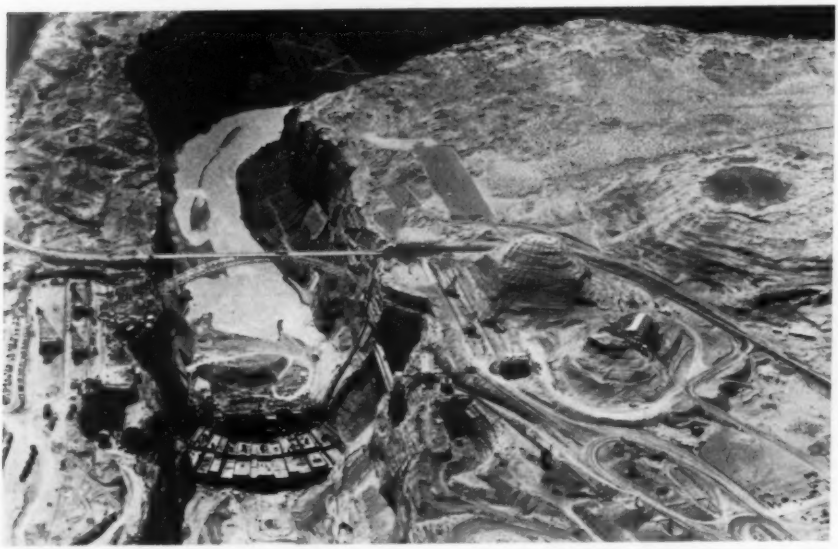


Fig. 2. Glen Canyon Dam, Ariz.

Photo was taken looking down the Colorado River. Dam will be 710 ft high.

Since the Colorado River Compact had apportioned water between the two subbasins but had not defined the separate rights of the various states, the 1946 report emphasized the need for a definition of the rights of states before projects could be finally selected for development. The upper-basin states responded promptly, and in 1948 signed the Upper Colorado River Basin Compact, which apportions the upper-basin water among the respective states. The compact was approved by Congress Apr. 6, 1949. The lower-basin states were unable to reach a voluntary agreement. A determination of their rights, the rights of the United States, and of the Indian reservations affected is pending before the US Supreme Court in the case of Arizona versus California. A special master appointed by the Supreme Court, after extensive bearings, has submitted his findings and recommendations to the court, where further action is pending.

Upper-Basin Development

With the water right of each upper-basin state defined in the 1948 com-

pact, the Bureau of Reclamation formulated a comprehensive plan for upper-basin development. The plan is outlined in the bureau's report of December 1950.[1] Supplements to the report, prepared in 1950[2] and 1951,[3] give details on each of the participating projects recommended for initial development. After extensive hearings before congressional committees, the initial plan, with some modifications, was authorized on Apr. 11, 1956. This act authorized four storage units of the Colorado River Storage Project and eleven participating projects. It also gave priority in the completion of planning reports to 25 potential projects in the upper basin.

The units of the storage project comprise large dams, reservoirs, and hydroelectric powerplants on the main stem of the Colorado River and its principal tributaries in the upper basin. Their primary purpose is to regulate the flow of the river, balancing out the wet and the dry years, so as to fulfill compact obligations to the lower basin at Lees Ferry on a continuing basis, and at the same time to permit water-consuming uses in the upper basin as provided for in the compact agreement.

Revenues from the sale of power generated at these dams will repay the cost of the dams and power plants. The costs for commercial power will be repaid with interest. The revenues will also help repay the irrigation costs of participating projects. The four authorized units of the storage project are now under construction. They are the 710-ft high Glen Canyon Dam on the Colorado River in Arizona and Utah (Fig. 2), the 502-ft high Flaming Gorge Dam on the Green River in Utah and Wyoming (Fig. 3), the Navajo Dam on the San Juan River in New Mexico and Colorado, which will be the ninth-largest earthfill dam in the world, and the multiple-dam Curecanti unit on the Gunnison River in Colorado.

Together, these four units will provide about 35,000,000 acre-ft of reservoir capacity and about 1,100,000 kw of installed generating capacity. About 80 per cent of both capacities will be provided by the Glen Canyon unit alone. When completed, Glen Canyon Dam, which will create a lake 186 mi long with a shore line of almost 2,000 mi, will be the fourth-highest dam in the world, second in height in the United States only to Hoover Dam. Lake Powell, formed by Glen Canyon Dam, and Lake Mead, behind Hoover Dam, will be the two largest man-made lakes in the western hemisphere.

The eleven authorized participating projects are planned to provide water for more than 114,000 acres of presently dry land and to provide supplemental water to about 233,000 acres presently irrigated. The projects will also provide water for certain municipal, industrial, and other purposes. Construction has begun on three of the participating projects, and preconstruction activities are proceeding on the others.

Municipal and industrial water requirements in the sparsely settled upper basin have thus far been nominal. Significant new requirements are developing, however, mainly because of the basin's vast mineral resources. In the upper basin, an area about the size of Arizona, are 33 per cent of the United States coal reserve, the world's largest known reserve of shale oil, and great bodies of uranium, potash, phosphate, trona, and other minerals.

Utilization of these minerals is attracting many people to the area. The population of the four states of the upper basin—Colorado, New Mexico,

Utah, and Wyoming—increased by almost 33 per cent in the decade 1950–1960, compared to an average increase of 19 per cent in the United States as a whole.

Fig. 3. Work on Flaming Gorge Dam, Utah

This dam on the Green River will contain 1,000,000 cu yd of concrete.

The effect of mineral resource development on a basin community is illustrated in the case of Farmington, N.M., which grew to more than 20,000 people in 1960 from less than 4,000 in 1950 as a result of gas and oil developments in the "four corners" area where Utah, Colorado, New Mexico, and Arizona have a common meeting point. In the past decade the population of Moab, Utah almost tripled as a result of uranium discoveries in its vicinity. This community will ex-

perience further expansion as an outgrowth of a $30,000,000 potash development currently under way in its environs. Here, too, the Bureau of Reclamation has made a preliminary investigation of means of providing additional water when it becomes needed.

A Denver firm of consulting engineers prepared a report for Colorado on water requirements for shale oil.[4] Some of the conclusions reported are: by 1975, shale oil production in the vicinity of Rifle, Colo., will reach 1,250,000 barrels per day; diversion requirements for water for municipal and industrial purposes in this 30-mi stretch of the Colorado River between Rifle and De Beque will increase by more than 200,000 acre-ft by 1975.

Accommodation for Rapid Development

The Bureau of Reclamation is mindful of such future water needs. Thus it is devising specific ways of meeting them and is providing capacity in the main-stem reservoirs now to assure future development under the compact. Sources under present consideration are the potential Ruedi Reservoir of the Fryingpan-Arkansas project, the West Divide project, and the Flattops unit of the Yampa-White project.

The effect of mineral resource development and impending population growth on potential reclamation developments in the upper basin is illustrated also in the case of the Seedskadee project. This southwestern Wyoming development is one of the eleven participating water use projects which are companion authorizations. It is planned to divert water from the Green River for the irrigation of presently undeveloped range lands. Just as construction was about to get under way, it was discovered that part of the project lands was underlain with commercial trona deposits, the mining of which might cause enough surface settlement to interfere with an irrigation system. Some adjustments in the projects area are being made to accommodate this condition.

The Seedskadee project plan originally did not include water for municipal and industrial use. Wyoming, however, following an independent study of future water requirements for these purposes, requested that the planned project reservoir be enlarged by 60,000 acre-ft to meet prospective water needs other than irrigation. The state is so confident that the water will be needed for municipal and industrial use that it is willing to repay the added cost of the larger reservoir.

Other Plan Changes

The rapidly expanding need for municipal water is illustrated in the case of the Central Utah project, largest of the authorized participating projects. Its principal feature will be a diversion of water westward from the Colorado River Basin to the Bonneville Basin. Part of this water, under the 1950 project plan, would have been used for irrigation of undeveloped lands in the Salt Lake Valley south of Salt Lake City.

Preconstruction investigations now in progress are showing that some of the land that was to be irrigated has been occupied by urban developments and the remainder is highly priced in anticipation of similar occupancy. Land values are too high for agricultural development. The project water formerly intended to be used for irrigation will now be required in the same area for municipal and industrial use. Water exchanges will be neces-

sary in view of the higher quality of water required for these purposes.

In 1955, the Bureau of Reclamation outlined in reconnaissance scope a potential irrigation development on Hams Fork near Kemmerer, Wyo. Now much of the water that would have been used by that project will be required by pending industrial developments. About 15,000 acre-ft per year will be used at the 500,000-kw steam-electric generating plant. A water filing on Hams Fork has also been made for a coking plant.

The high value of municipal and industrial water usually enhances the justification for a reclamation development when these purposes are included in the project plan. The Bureau of Reclamation must consider these and other water needs to meet them so far as practicable in formulating its project plan.

Conclusion

Because of its scarcity, water is especially valuable in the Colorado River Basin. Its development, perhaps more than anything else, will unlock the door to the upper basin's vast resources in land, fuels, fertilizers, metals, timber, and recreational attractions. There are no important ground water resources in the upper basin, so surface streams must be relied on to meet the growing water needs. The entire river basin is an example of how wise development and use of natural resources can enrich national life and economy.

References

1. Colorado River Storage Project & Participating Projects. House of Repr. Document 364, 83rd Congress, 2nd Session, Washington, D.C.
2. Colorado River Storage Project & Participating Projects. Supplement to House of Repr. Document 364, prepared by Bureau of Reclamation, Washington, D.C. (1950).
3. Colorado River Storage Project and Participating Projects. Supplement to House of Repr. Document 364, prepared by Bureau of Reclamation, Washington, D.C. (1951).
4. Water Requirements for Oil Shale, 1960–1975. Prepared for State of Colorado by Cameron & Jones, Inc., Denver, Colo.

Water Resource Problems in Michigan

Norman F. Billings

A paper presented on Jun. 6, 1961, at the Annual Conference, Detroit, Mich., by Norman F. Billings, Chief, Hydrology Div., State Water Resources Com., Sta. B, Lansing, Mich.

IN many respects, Michigan's water resource problems typify those of the entire United States. This statement may seem rather remarkable in view of Michigan's water resource abundance—an abundance so impressively displayed by the vast freshwater seas that nearly surround the state. But although this plenitude may appear to contrast strongly with water resource shortages in many other states, it is by no means always and everywhere available, and problems of water scarcity occur in Michigan even as they do in more arid states. For example, the great supply contained in Lake Michigan is attainable only to those communities that can afford the expense of costly pipeline and stormproof intake structures. Most of the state's smaller towns must do the best they can with local ground water sources.

Michigan has problems of low streamflow and floods, pollution and water rights, drainage and erosion, and even salt water problems. Possibly its greatest water resources problem—the one most widely shared among all states—is the failure of the public to recognize signs of trouble and to take action wisely and in time. Herein lies the basis for the real similarity between problems that are physically unlike. A flood in the lower Mississippi River area differs greatly, in degree, from a flood along one of Michigan's small streams, but solving either involves the same difficulties in convincing the public first that something should be done and second that the right thing should be done at the right time.

Water Resource Summary

A summary inventory of Michigan's water resources lists 11,037 inland lakes, 33,350 mi of inland streams, 36,575 sq mi of Great Lakes abutting upon 2,274 mi of mainland shoreline, and very extensive ground water reservoirs. All these resources are sustained by an average annual rainfall of about 31 in. that is well distributed seasonally, with somewhat greater monthly averages during the growing season months than at other times of the year. Substantial departures from annual and monthly averages occur.

This is an impressive inventory and one in which the people of Michigan take much pride. Not only is the quantity of water large but also the glacial geology and northern forest vegetation provide an environment that enhances the quality of the state's water resources, especially for recreational purposes. Because of the apparent abundance of excellent water, however, and because of Michigan's still extensive drainage problem, the

supply is taken for granted and rather lavishly used, or misused. As with land during the early settlement of the United States, there has always seemed to be plenty of water in Michigan—too much, certainly, to worry about.

Early History

The drainage problem, coming as it did so early in the state's history, may have been an important influence on the whole philosophy of water resource management. Drainage was then essentially a problem for the farmer, just another of the many problems that beset the pioneer agriculturist and one that, like the others, was up to him to solve or live with. The state did go so far as to recognize the need for some coordination of action and sharing of costs among the farmers and enacted laws providing for the creation and operation of drainage districts. The basic principle, however, was one of local action and local financing, with the state remaining aloof from any participation except the intermediary service performed by the director of agriculture in intercounty drainage districts.

Very early in its history, Michigan had a different attitude toward resource development. As soon as its admission into the Union became certain, Michigan began a vast program of canal and railroad construction and river navigation improvements. The program failed and nearly bankrupted the state, which forthwith withdrew behind a constitutional amendment stringently limiting any further engagement in works of internal improvement. From that day on until the constitutional restriction was relieved by further amendment in 1946, water resource development was left strictly to local units of government, special purpose districts, or private interests. No profound change in policy has marked developments in the ensuing 15 years. The state does now participate in a modest cooperative program of small-boat harbor construction along Great Lakes shores.

State Control

In contrast with the state's nonparticipating policy in water development, the Michigan public has demanded and obtained very active participation in control of public water supply and waste disposal into public waters. The Michigan department of health's supervision of public water supplies has given the state a widely recognized and enviable reputation for safe drinking water in its public systems. Stringent laws support the department's enforcement of construction and operation specifications that cover supply wells to house services.

Waste disposal control comes under the authority of the department of conservation, the department of health, and the water resources commission. Under Michigan's oil and gas well laws, the department of conservation has supervised the drilling and production of more than 23,000 wells, with virtually no pollution of fresh water resulting. Intermeshing statutes provide authority for the eminently effective and widely emulated pollution control program of the department of health and the water resources commission. Present-day pollution is limited to a very few long-standing cases for which correction is exceedingly expensive and is necessarily tailored to long-range plant improvement programs, and state control activity is now largely

devoted to appropriate restriction of new waste disposals.

Water Supply

Public water supply, like drainage, has evolved entirely from local development. Early needs in most areas could easily be met on that basis, for adequate supplies could be drawn from the ground within the corporate limits of nearly all cities and villages. The major exception, Detroit, soon became economically strong enough to construct an intake into the Detroit River. As certain other cities outgrew their once adequate local sources, they similarly found themselves capable of financing pipelines to the Great Lakes. Others, however, have experienced some difficulty in meeting their requirements from local sources but lack the financial ability to utilize distant sources.

Waste Disposal

Municipal waste disposal also has followed the pattern of local development. So far, all cities have found local receiving waters capable of assimilating their properly treated effluent or have been able to make contractual arrangements with neighboring larger cities or other municipal corporations for sewage treatment and disposal.

Waste disposal, however, is a growing problem of suburban residential areas that are faced with serious obstacles under present tax limitations in financing treatment either independently or by contractual arrangement with other municipalities. In many instances, the suburban areas lack a big enough local stream to assimilate even the effluent of properly treated waste.

It is evident that the limitations of natural streamflow to assimilate wastes will become an increasingly critical factor in inland municipal and industrial development. Michigan streams, like those of many other states, decline to rather meager volumes during ordinary drought. Except where the waste can be stored for release during high streamflow, which is feasible in only a limited number of instances, it is the low flows that set the effective limits on the waste-assimilating capacity of receiving streams.

Low-Flow Augmentation

Some important possibilities exist for storing seasonal excess water in impounding reservoirs and releasing it during drought to augment the natural streamflow. Michigan's topography, however, does not provide very many sites that are suitable for such reservoirs; existing sites are steadily being developed for other purposes. Three big difficulties attend the realization of this potential for increasing the waste-assimilating capacity of streams: (1) finding and evaluating the possible reservoir sites, (2) reserving them for development as needed, and (3) financing and constructing the reservoir projects.

Topographic maps are deficient for much of the state where low streamflow is a problem. Some of the area has not been mapped at all, much of the mapping that was done took place so long ago that cultural features have greatly changed, and the contour intervals of most available maps are so great that even rough evaluation of reservoir sites requires considerable field surveying.

When sites are found, reserving them for future development necessi-

tates payment to the land owners and is likely to involve actual condemnation. In the absence of present or clearly imminent crises, interest by the affected cities and industries in advancing the necessary cash is, so far, little more than academic. It is by no means certain that industry could be given the condemnation powers that would be needed.

The most urgent need is to find and reserve the reservoir sites. Developing them will be a question of economics and could be undesirably delayed or even prevented by the inability, under the realities of bond salability, to anticipate their benefits. The same legal problems that hamper the reserving of sites will apply to their development. Another complication in operation of reservoirs for low-flow augmentation is the present lack of statutory protection for the released flows. Withdrawals of the water enroute to the areas of municipal use are presently subject only to common-law restrictions.

Water Rights Legislation

Abstractions for irrigation not only threaten to deplete releases of stored water but are already reducing the natural low flow of streams. So far, the reduction is slight, except in a few areas, but the trends showing that the practice is increasing rapidly portend real difficulty in the not-too-distant future. State water rights legislation is needed to protect essential uses and to provide for new uses as well. It is hoped that such legislation will be enacted in time to prevent the delay of reservoir use for low-flow augmentation.

Lakes

Among Michigan's abundant water resources are inland lakes. All but two of Michigan's 83 counties have lakes, large numbers of them in most counties. Lakes are traditionally used freely by the public for recreation and, despite their abundance, not generally used for municipal water supply, simply because colder and cleaner ground water is similarly abundant. Lakes have accordingly taken on an almost entirely recreational value in the public mind, and any uses not fully compatible with recreation are not likely to meet with public favor.

The control of inland lake levels and development of their shores are, under present law, entirely the responsibility of local government. In some localities, careful attention has been given to stabilization of levels and to guidance of development by proper land use zoning. In other localities, fluctuations in level are unrestricted, and frontage subdivision and use proceed according to the choice of the owner.

Ground Water

The widespread availability of ground water for domestic, industrial, and even municipal supply has undoubtedly been the chief cause of deficiencies in ground water information that handicap expanding use of that source. In most areas, people are used to having all the water they need and often fail to appreciate the importance of insuring continued supply by timely surveys and planning. For that matter, the scientific appraisal of ground water supplies is still of rather recent development. Not only the general public but also many water supply people are unfamiliar with the practical-

ity of such studies. The idea is still widely prevalent that water is where you find it, that the way to find it is to drill wells, and that the time to drill new wells is when the old ones become inadequate to meet demands. This idea has been supported not only by the usual ultimate success in finding additional supplies but also by the great complexity of Michigan's geology. When one test well encounters nothing but fine sand and clay and another well only a few rods away strikes good, water-bearing gravel, the basis for scientific study is not apparent to the public. It is becoming increasingly clear, however, that good initial yield is not the only criterion of a well's production capacity, that wells do seriously interfere with each other's pumping, and that the future development of ground water supplies must depend more and more on careful scientific study conducted well in advance of production needs.

Water Excesses

Like most other states, Michigan has its problems of excess waters. Mention was made earlier of the drainage problem; local floods also occur in the state. In very few instances, however, have floods been large enough and frequent enough to inspire the public support requisite for their control. Nearly all the drainage is intrastate, the rivers are relatively short, and floods are generally of brief duration. They occur with little warning and dissipate rapidly after the causative rain or snowmelt is over. Thus, although damage may be severe, most floods are not in the public eye long enough to make a really firm impression. Until the spring of 1961, it had been 13 years since the occurrence of severe and widespread flooding, and 57 years since the record floods of 1904. This respite, although gratifying, has worked further to dull public concern. Within the last 2 years, two state projects of the US Army Corps of Engineers had to be shelved for lack of local arrangements to assume nonfederal responsibilities and costs. Meanwhile, the flood damage potential grows as the hazard areas are built up for various purposes.

Excess water also causes soil erosion, both on land and in stream channels. Although very commendable gains in the alleviation of this widespread problem have been made under the nearly statewide organization of soil conservation districts, much still remains to be accomplished. Soil erosion control on the farm is obviously justified on a purely economic basis. On nonfarm properties, especially the so-called wild lands, the immediate economics is less favorable; and the benefits from control of siltation in the stream channels themselves are largely intangible and accrue principally to the general public. One large but special-interest segment of the public, the fishermen, is supporting a most laudable program of stream sedimentation control that is carried on by the department of conservation with funds from fishing license fees. This program, however, is very small when compared to the extent of the problem. Neither does it seem entirely equitable for the entire burden of its cost to be placed on fishermen when everyone is served by the improvements.

Waterway sedimentation in Michigan is less spectacular than in some other regions, because the soil content in many river basins runs heavily to sand. This material settles out quickly

after floods or freshets subside, leaving the water clear and the bottom attractive so that the casual observer sees little cause for concern. But the sediment fills pools and reservoirs, aggravates floods and bank erosion by decreasing channel depth, shoals and warms the water, and impairs drinking water quality—all in addition to destroying fish habitat.

Conclusion

The water resources of Michigan are substantial, varied, and valuable. They are widely used and enjoyed for many purposes but are not in all respects as fully appreciated as they probably should be. A wide range of problems attend the Michigan water scene, many of which stem from lack of consideration and foresight or from public reluctance to come to grips with the issues.

Attainment of the necessary public interest and the coordination requisite to optimum water resource planning and development are believed to be contingent to a considerable degree on adequate public information. This lays down a real challenge to water resource authorities and officials to convey salient facts and opinions to the people who must make decisions. As water resources people are not generally trained as educators, this challenge poses some difficulties. It is the author's belief, however, that shortcomings in educational training can be offset very importantly by straightforward honesty, objectivity, courtesy, and completeness in telling the story. The catchy, attention-arresting language and kindergarten displays of today's ubiquitous "hard sell," the unending pressure campaigns for this worthy cause or that, and prophecies of dire trouble ahead are certainly less than fully convincing, perhaps partly because they are each so obviously and desperately slanted toward some specific objective. Simplicity and integrity and, above all, respect for the public's intelligence, take on refreshing appeal in this atmosphere.

Discussion

T. L. Vander Velde

Chief, Water Supply Sec., State Dept. of Health, Lansing, Mich.

The author is highly qualified in the field of water resources, especially as it relates to Michigan, and he has covered his subject very thoroughly and well.

The article mentions the close control of the Michigan conservation department over oil well drilling. This is particularly important in the light of increasing pressures to drill oil wells in the Great Lakes, efforts that very judiciously and deliberately have been prohibited to protect this valuable water resource. Experience has proved that such activities lack perfect mechanical control and therefore must be prohibited.

Reference is made in the article to the rather recent tools for evaluating ground water potentials and possible productivity. The writer wholeheartedly agrees that the use of such tools in studying ground water resources needs to be more widely recognized. To emphasize this fact, the consulting engineers in Michigan recently sponsored three 2-day sessions of a ground water supply conference. At the con-

ference, working tools were reviewed and studied. Such a conference should be considered by other engineering groups.

The use of these tools is quite necessary to evaluate the effect of new or existing wells in one municipality on wells in another municipality or on private or industrial wells within the municipality. The resultant legal implications will become more acute, and the problem should be studied so that all the water that is available may be used without encroaching on the rights of other municipalities.

Communities should recognize the need for joint solutions to water problems. The need for building impoundments, long pipelines to, and intakes in, the Great Lakes, and large feeder mains from central treatment plants is no longer always solvable by individual municipalities. The financial requirement demands a pooling of financial resources to acquire important water resources.

Monthly Water Bond Interest Costs and Sales

A report of the Chief, Basic Data Branch, Div. of Water Supply & Pollution Control, US Public Health Service, Washington, D.C.

Month	1960-61 Net Interest Cost—*per cent*		Total Bond Sales—*$1,000,000*		
	General Obligation Bonds	Revenue Bonds	1960-61	1959-60	1958-59
Jun.	3.77	3.77	11.4	50.3	20.1
Jul.	3.99	3.93	133.1	17.3	39.0
Aug.	3.34	4.02	48.4	25.5	37.7
Sep.	3.82	3.75	18.8	16.6	14.3
Oct.	3.64	3.85	21.0	68.4	60.8
Nov.	3.36	3.86	18.4	36.3	42.5
Dec.	3.55	4.20	77.3	18.4	11.5
Jan.	3.88	3.70	37.8	21.2	28.3
Feb.	3.41	3.71	19.4	41.7	62.1
Mar.	3.47	3.48	102.8	19.5	57.0
Apr.	3.85	3.81	16.2	38.2	44.4
May	3.36	3.62	48.9	49.9	105.5
Total			553.6	403.3	523.2

Great Lakes as a Water Source

Arthur Rynders

A paper presented on Jun. 7, 1961, at the Annual Conference, Detroit, Mich., by Arthur Rynders, Supt., Water Works, Milwaukee, Wis.

THE Great Lakes are about 10,000 years old. Like all lakes, they began to shrink from the time of origin. Detroit and Chicago are built on the beds of receding lakes. The Great Lakes are one of the world's largest reservoirs of potable water. A comparison with other large fresh-water lakes indicates the magnitude of this reservoir (Table 1).

Water flows into the Great Lakes from all directions, draining almost 300,000 sq mi. Together, the chain of lakes and the St. Lawrence River extends halfway across North America. The distance by vessel track from Duluth-Superior to the Atlantic Ocean is 2,314 mi. The combined shore line of the Great Lakes alone is almost 8,000 mi. Tributaries to the Great Lakes include 100,000 mi of streams and 30,000 lakes.

The boundary between Canada and the United States traverses four of the lakes. In Canada, only Ontario has frontage on the Great Lakes. In the United States, Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York all have lake frontages. Each state holds title to the waters of the Great Lakes within its boundaries. Only Lake Michigan lies wholly within the United States.

The lakes are nontidal, but variations in lake levels of 8 ft, caused by the combined effects of storms, current, evaporation, rainfall, and discharge have been recorded in some locations. The peculiarly cyclonic nature of Great Lakes weather blows up great gales in hours. Variations in lake levels are ordinarily 4 ft or less over a period of years. The lakes are free of ice 8 months of the year. The average mean air temperature of the area is 50°F; the average precipitation is 35 in.; and the average altitude of lake levels is 500–600 ft above sea level. The water temperatures vary from 32°F to 70°F.

The water in an unpolluted state is considered an ideal potable water. The water has some natural hardness, but not enough to justify softening, in the opinion of most customers. Total solids seldom exceed 150 ppm.

The estimated population of the Great Lakes drainage area is 25,000,000 in the United States and 5,000,000 in Canada. Of this total, about 20,000,000 people, working in industries, are concentrated in the urban areas on the shores of the Great Lakes or their interconnecting channels. For the most part, these concentrations had their beginnings a little more than 100 years ago. For what they may be worth, projections of the region in 900 years indicate concentrations comparable to those in the Ruhr Valley in Europe, extending back from the shores of the lakes as much as 30 mi and along the shore for hundreds of miles in favored locations. These projections in time, population, and indus-

trial growth in the watershed from which drinking water must be drawn presage a program of water pollution control far beyond anything now known.

Uses of Great Lakes Water

The present and projected growth of the area can be attributed to the use of the water of the Great Lakes. In considering the various uses, it may be well to view them in the order of precedence established by treaty. Article VIII of the treaty between the United States and Great Britain relating to boundary waters, signed Jan. 11, 1909, states:

> The following order of precedence shall be observed among the various uses enumerated hereinafter for these waters, and no use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it in this order of precedence:
>
> 1. Uses for domestic and sanitary purposes
> 2. Uses for navigation, including the services of canals for the purpose of navigation
> 3. Uses for power and for irrigation purposes.

This order of precedence is highly significant in that domestic and sanitary purposes, which are so closely related to water utility operation, are given priority over all other uses. It is also significant that other water needs, such as industry, recreation, and the support of fish and wildlife, which have come into prominence since the treaty was signed, are not specifically cited.

Available data indicate that the use of water by utilities in the Great Lakes area in 1960 is 6 bgd; in 1980 it will probably be 8 bgd; and by 2000 it will be 12 bgd. The use of water by utilities today is in a ratio of 1:27 compared with the runoff of 246,000 cfs through the St. Lawrence River.

For some time, the Great Lakes have been a continental crossroads with terminals for inland water, rail, highway, and air transport. This transportation has made it possible to market the natural resources of the area, the produce of the great agricultural areas, and the products of industry. The Great Lakes are one of the most used waterways of the world. The completion of the St. Lawrence Seaway will increase this use because the seaway makes Liverpool and Hamburg closer to Cleveland than to Baltimore. Chicago, Milwaukee, Detroit, and Duluth are now as close to Europe as Miami or New Orleans. There are 60 major ports on the United States side and 22 on the Canadian side of the Great Lakes. The US Army Corps of Engineers estimates that the total annual overseas general cargo traffic of United States lake ports will be 6,700,000 tons by 1985.

TABLE 1

Comparison of the World's Largest Lakes

Lake	Surface Area *sq mi*	Capacity *cu mi*	Maximum Depth *ft*
Great Lakes	94,700	5,457	
Superior	31,800	2,935	1,333
Victoria (Africa)	26,200		270
Huron	23,000	849	750
Michigan	22,400	1,170	923
Baikal (Russia)	13,300	5,785	5,413
Tanganyika (Africa)	12,700		4,708
Erie	9,900	110	210
Ontario	7,600	393	802

Use of Great Lakes water for power includes both steam and hydroelectric generation. In the relatively few streams or waterway locations where

heat pollution has been experienced, the solution appears to be to locate the steam generating plant on the lakeshore where ample cooling water is available. Hydroelectric plants are regulated in accordance with treaties and agreements.

Mention should also be made of a few other uses, such as the commercial fisheries, with annual catches ranging in value from $10,000,000 to $17,000,000; the hundreds of thousands of vacationers accommodated in this area with its thousands of small lakes in addition to the Great Lakes themselves; and the unusually scenic locations afforded along the shore for homes, apartments, hotels, restaurants, and a great variety of other facilities.

Pollution of Great Lakes Water

The water drawn from the Great Lakes by some water utilities is, by some standards, polluted. The matter of pollution is one of concern to the utility because thus far, efforts to eliminate it have not been successful. As used here, water pollution control is understood to be the surveillance of the composite quality of all the water in and flowing into the lakes, together with any effects on the unpolluted state of the lake water. Of particular interest are the effects on the quality of sources of water utilities. The composite quality of the surface waters is affected by:

1. The liquid wastes from industries with nonutility water supplies
2. The liquid wastes from water utility customers
3. The effectiveness of liquid waste and sewage treatment
4. Natural runoff, both urban and suburban
5. Stream pollution
6. Air pollution washed into surface water by precipitation
7. Wastes from marine traffic
8. Growths of algae and seaweed due to nutrients in the water flowing to the lakes.

Obviously, the surveillance of the composite quality of water flowing into the lakes is complicated. A short discussion of air pollution—generally classified as insignificant—will illustrate the point. Home heating and the exhaust fumes of motors in the Great Lakes area release over 4,000 tons of solids and 1,000 tons of gaseous pollutants into the air every day. Industrial airborne pollution from both combustive and noncombustive activities adds more pollution. A considerable part of this pollution is carried to the lakes.

Viewed objectively, it would seem that there should be one comprehensive water pollution control authority established for the entire Great Lakes Basin. At present, each of the eight states and the one province in the basin have a great variety of authorities for segments of water pollution control.

To help find a solution to the water pollution problem, USPHS has begun staffing its Chicago offices for a $500,000 survey of pollution in Lake Michigan and the Illinois River. It is understood that this survey is to be expanded to all of the Great Lakes in a $12,000,000, 6-year program.

The surface waters of the Great Lakes area are one of the principal assets of both Canada and the United States. The conservation and management of these assets are of vital importance to the economy of both nations and particularly to the economy of the Great Lakes area.

Ground Water Quality and Management in the Great Lakes Area

Lynn M. Miller

A paper presented on Jun. 7, 1961, at the Annual Conference, Detroit, Mich., by Lynn M. Miller, Hydrologist, Jones, Henry & Williams, Toledo, Ohio.

ALTHOUGH this article is limited to a discussion of ground water, management cannot limit its concern to ground water quality. The quality of water affects the proper development and operation of any system using a ground water source.

Many of the problems that management faces with ground water are similar to those with surface water. The maintenance of services and distribution mains, adequate prime and usable storage capacities to meet peak load demands, practical revenue rates to provide a sound financial structure for maintenance and expansion programs, public relations, and other problems are the same with either kind of source.

Ground Water Sources

Nearly all ground waters in the Great Lakes area are produced from glacial drift sand and gravel or consolidated sedimentary rock formations. Thus, percolating waters are exposed to a great variety of granulated mineral materials, and soon carry the ionic portions of a compound mineral environment. Buried organic materials have additional components to alter the quality of percolation waters. Many of the consolidated rock formations retain certain saline qualities from the marine seas in which they were deposited. Other rock formations depend on secondary permeability for their capacity to store and yield water; these formations offer no filtering media for more objectionable organic contamination. Many of the shallow aquifers are vulnerable to contamination, and in this respect differ from surface sources only in the time delay required for percolation.

Average Quality

The heterogeneous dispersion of mineral complexes in the glacial drift often results in wide variation in the occurrence of a particular ion—notably iron—within short lateral distances. It is not uncommon, however, for water quality to change in a given well when infiltration from a stream or other surface source takes place under heavy draft. Thus seasonal changes in quality may be noted. In general, however, the quality range of ground waters will not be as great as that of the surface waters in the area.

The characteristics of quality of greatest concern to management are iron, hardness, chlorides, and such localized problems as hydrogen sulfide and methane gases. On the average, Great Lakes area ground waters have the following nature: they are hard (250–500 ppm) and contain objectionable iron (0.3–5 ppm) and moderate chlorides (0–200 ppm). The

mineral complex has a considerably greater range than any of those, but is so variable that the limits of space for this article do not permit its discussion. It can be stated that very few ground waters in their raw state represent a superior water for domestic service uses; very few are even satisfactory. There is a vast difference in public opinion concerning the degree of treatment which should be accomplished to provide desirable water qualities. This difference of opinion is usually related to the cost of adequate treatment facilities.

Treatment Problems

Many areas of urban and suburban development have difficulty in locating adequate quantities of potable water at one or two locations. It is often necessary, therefore, to develop a number of wells or well fields. These wells at widely separated points operate intermittently as the consumptive demands require. Small, individual water-conditioning units at each source require a large expenditure, in total, for maintenance and operation. The degree of conditioning that can be accomplished economically is limited to the feeding of various chemicals such as chlorine, phosphates, and fluorides. Treatment of this nature does not produce truly conditioned water of the most satisfactory quality. Usually some iron problems remain, and the water is hard. Also, the individual wells often yield waters of somewhat different quality, and the regulation of feed equipment must be maintained at arbitrary levels. The result is a fluctuating water quality which is the source of many complaints and problems to water management.

A few municipalities have gone to the expense of developing elaborate collection piping to conduct the water produced from a number of wells at scattered locations to a central point for complete treatment. The usual distribution mains, which may in effect be a near duplicate of the collection system, are still required. The extraordinary installation costs and maintenance of this are evident.

Quantity and Quality

One of the most vexing problems facing management is related to the economics of developing the additional capacity required by explosive urban growths. In many cities more capacity can be developed without great areal expansion if quality factors are ignored. Other localities must venture afield to locate suitable sources of supply. If distant, high-capacity well fields can be developed in small areas, treatment is, or would be, possible at the source. Thus expansion in that direction could be encouraged. The situation is more complicated where sources of only moderate capacity and over a very large area can be developed.

Another hydraulic phenomenon that is getting increased recognition is the interconnection of surface and ground waters. New quality problems may arise when well field capacities are increased by the spreading, ponding, or direct recharging of surplus surface flows. Such practices have a decided effect on the mineral qualities of ground water and may incorporate some organic and contamination materials foreign to the ground water aquifers.

Legal Questions

The legality of urban trespass on the ground water rights of rural individuals has yet to be determined in most of the Great Lakes area. Those

cases which have reached the courts are so old that they have little in common with today's economic and social environment. Nevertheless, this is a problem that must be answered by and with water utility management. If the legal status of ground water rights can be determined, the quality control problems of management can be properly handled by advance planning.

Future Development

Many urban areas are seriously considering the virtues of long pipelines to one of the Great Lakes to ease the problems of water rights and to facilitate the economic development of proper treatment facilities for furnishing a top-quality finished water. International treaty restrictions will limit the extent of such endeavors, but some large urban areas will carry projects of this nature to conclusion. Many small communities will also benefit from those projects. The area water rights problem must still be solved, however.

With total resource development and management, all interests will be justly acknowledged and served. The result of such management will be an increasing demand for more extensive water conditioning plants by progressive communities using ground water. Integrated into the resource management will be a qualitative and quantitative revaluation of ground water sources based on artificial or induced recharge practices. The need for at least precautionary monitoring of produced water quality is evident. Waste disposal and water contamination practices will be more stringently regulated at the insistence of progressive water utility management.

Infectious Hepatitis Epidemic at Posen, Mich.

John E. Vogt

A paper presented on Apr. 6, 1961, at the Symposium on Ground Water Contamination, Robert A. Taft San. Eng. Center, Cincinnati, Ohio, by John E. Vogt, Director, Div. of Eng., State Dept. of Health, Lansing, Mich.

DURING the spring and early summer of 1959 an outbreak of infectious hepatitis occurred in the village of Posen, Mich. Posen is a Polish Catholic community with an estimated population of about 400. It is located in Presque Isle County in the northeast part of Michigan's lower peninsula.

The people in Posen as a whole are a very close-knit group. An occasional trip to Rogers City or Alpena, the nearest communities of any size, is the extent of their normal travel. Community life centers around the church; the parochial and public schools; the chamber of commerce building, where wedding receptions, showers, and other social activities are held almost every weekend; and the local theater.

Geology and Hydrology

Geologically, in the immediate area around Posen is a thin veneer of glacial till with a maximum thickness of 3 ft. This till overlies the bedrock, of which there are numerous outcroppings throughout the area. The bedrock formations belong to the Traverse group of the Devonian age and consist mainly of limestones with some shale beds. These formations dip toward the center of the state at about 40 ft/mi.

No topographic maps of the Posen area are available, and without them, interpretation of the hydrology of the area is difficult. By use of the information available, however, a few general conclusions can be drawn regarding the hydrology. There appears to be a topographic high extending through the Posen area in a northwest-southeast direction. This could be caused by some resistant limestone beds within the Traverse group forming a low ridge paralleling the strike of the rock formations. The relief is not very great, but it is enough to be a controlling factor in the surface drainage. South of a northwest-southeast line through Posen the streams drain south, and north of this line they drain north.

Water level measurements in wells seemed to indicate that Posen is situated on a ground water divide that tends in a northwest-southeast direction. This ground water divide conforms to the surface drainage pattern, and parallels the strike of the rock formations in the area. South of Posen the ground water gradient is toward the southwest, and north of Posen it is toward the north and northeast.

Water Supply

Posen has no public water supply; all the individual wells are drilled into the bedrock, where they get water from joints, fractures, and partings along the bedding planes of the limestone formations. The wells range in depth from 11 ft to 180 ft, with most of them in the range of 30–40 ft, 60–70 ft, and

90–100 ft. Part of this wide range in depth of wells is owing to differences in elevation of the ground surface. Some of the deeper wells were probably attempts to obtain a safe water supply.

There was no apparent relationship between the depth of wells and the quality of water. At one point in the investigation, the observation was advanced that the majority of contaminated wells ranged in depth from 50 ft to 65 ft. A later compilation of data showed, however, that there was no correlation between depth of well and water safety.

Well Construction

A rather unusual method of well construction is used in the area. All wells are 6 in. in diameter with casings terminating at the ground surface. Most wells were cased to only a shallow depth, generally just through the glacial till and into the rock a short distance. The range of casing length was 10–30 ft, with one well having no casing at all. In one well, where the casing terminated at a shallow depth, it was determined that water was entering the well from a shallow formation above the static water level and below the casing.

In many installations the casings were cut off at the ground surface. Hand pumps were installed on top of the casings to be used during power outages. In practically all wells, however, there was no seal between the hand pump drop pipe and the well casing. The casing was entirely open to surface drainage. In wells where there was no hand pump, the casing was often covered over with some loose boards. Furthermore, there was no attempt made to seal the bottom of the casing in the rock. The power pumps were generally located in the basements of the homes, with a suction line running out to the well casing. Observations of visible construction features and questions asked of the well owners established that in many wells the connection between the suction line and the well casing was not watertight. Thus there were numerous sources of contamination through poor construction features such as open-top casings, unprotected suction lines, unsealed connections between suction lines and casings, and no seal between the bottom of the casings and the rock.

Location of Wells

Most of the wells were too near septic tanks, tile fields, or seepage pits. This proximity was particularly dangerous in view of the thin veneer of soil on top of the limestone. The excavation for some septic tanks had to be blasted out of the rock, with the tile field laid in filled ground above the rock. There was not much doubt that septic tank effluent traveled down through the thin mantle of drift into the rock and laterally through crevices in the rock for great distances with little change in its characteristics.

Water Quality

Laboratory results of water samples from the wells substantiated the field observations. Of the samples collected by the local health department over the previous 3 or 4 years, 30 per cent had shown evidence of contamination.

Thus, when the hepatitis cases began to appear, the wells in the community were suspected of being a contributing factor in the spread of the disease. During the investigation, a rather complete survey of all wells in the village north of the center of the community was made. Emphasis was

placed on the north side of the village, as there were practically no cases on the south side. As much information as possible was obtained concerning the construction of the wells and their location with respect to sources of contamination. Bacteriological analyses were made on all samples; nitrates, nitrites, and detergents were checked on many. Within the village, 47 per cent of the samples showed the presence of coliform organisms. Forty-four per cent of the wells were inadequately located with respect to sources of sewage pollution, and 70 per cent had buried suction lines that were not protected in any way. Of the ten wells checked for detergents, four showed positive determinations. One of these wells served the chamber of commerce building. Another served the residence of the local druggist, where all members of the family suffered severe cases of hepatitis. The other two wells with positive determinations will be discussed in more detail below.

Influence of Weather

The area had experienced subfreezing weather since Thanksgiving. For 3 consecutive days during the middle of March 1959, the temperatures rose to well above freezing, with a considerable melting of snow. On Apr. 3, the village was blanketed with a 10-in. snowfall. Following this there was a light rain, and by Apr. 15, all the snow was gone and runoff was complete. By this time, the wells in the village were producing highly turbid water, which might be expected in view of the geology, the construction of the wells, and the heavy runoff. The local health department advised all residents to boil their water. To aggravate conditions further, during the first week in May there were heavy rains, with practically every basement in the community being flooded.

Spread of the Disease

Infectious hepatitis was first reported in the nearby community of Hillman in January 1959. The first cases appeared in Posen in the middle of April, but were apparently unrelated with those in Hillman. The beginning of the outbreak occurred in three families living in the area referred to as Upper Posen, on the north side of the community. About the middle of March, a relative of one of these families visited them, and during his visit, became ill and was diagnosed as having infectious hepatitis. This first case occurred just at the time when the above-freezing temperatures produced considerable runoff in the area, and when the heavy snow and light rain compounded the problem.

The septic tank serving the home with the first hepatitis case was only 6 ft from the well on the same property. This well, like most of the wells in the community, had a 6-in. casing driven to the shallow rock formation and cut off at the ground surface. A power pump was located in the basement, with a buried suction line to the well. A hand pump was set over the casing, but was not sealed to afford a watertight joint. It was easy to understand how this well, near the septic tank and poorly constructed, was contaminated.

The two houses immediately south of the one in which the hepatitis case developed were served by one well. This well was only 10 ft from the septic tank on the first property. It, too, had a power pump in the basement with a suction line. The top of the casing was "protected" by a couple of loose-fitting boards laid over it.

Within a 3-day period about 4 weeks after the discovery of the first case of infectious hepatitis, cases appeared in all three of these households. In all, there were sixteen cases in the three families. From this nucleus the disease spread rapidly through the community with epidemic proportions. A total of 89 cases was reported. The epidemiological study later brought out, however, that there were many more cases not reported. As soon as one person in a household became ill and was diagnosed as having hepatitis, people later developing similar symptoms were merely put to bed and not reported. Furthermore, it is very likely that there were many subclinical cases.

Effect of Hydrology

Hydrologic aspects of the area had decided effects on the spread of the disease. Superimposed on the ground water divide that runs through Posen, there appears to be a drawdown cone that has locally reversed the normal flow of ground water. This results in ground water flowing into Posen from all directions toward the low point in the cone of depression near the north central part of town. The existence of this cone of depression is indicated by the fact that numerous wells around the perimeter of the town yielded bacteriologically safe samples while wells within the village were yielding a higher percentage of unsafe samples.

As the ground water moved down the cone of depression toward the center of the village, the fringe area wells would be intercepting uncontaminated water. Further down the cone, however, contamination from septic tanks, privies, and sink drains would be added. Because the ground water moved through fractures, partings along the bedding planes, and other openings in the limestone, there would be little or no straining or filtration, and wells within the village would be intercepting contaminated water.

This cone of depression near the center of the village could be caused by two factors. If the permeability of the aquifer in the Posen area were low, the combined pumpage from the high concentration of wells in town may have lowered water levels locally, thus creating the cone of depression. This low permeability of the aquifer has since been verified by an automatic recording device which has been recording ground water elevations in a well near the center of town. The recorder showed daily water level fluctuations of 1–1.5 ft, and seasonal changes in the range of 6.5–10 ft. This is a considerable variation, as the pumps in the area all have low capacities.

The second possible explanation for this cone of depression would be a deep, uncased well in town which penetrates a water-bearing formation in the limestone with an artesian pressure surface lower than that of the water level in the upper formations. This, of course, would cause migration of ground water from the upper water-bearing formation down the well bore into the lower water-bearing formation, thereby creating a cone of depression in the upper formation from which the wells in town extract their supply.

There were reports that a well over 300 ft deep did exist in the village, but it was never located. A well this deep in Posen would probably penetrate the Rogers City limestone which underlies the Bell shale. The 80-ft thickness of Bell shale overlying the Rogers City limestone would constitute an effective aquiclude, and the artesian pressure surface in the Rogers

City limestone could be lower than the water level in the Traverse formations. An uncased well penetrating the Traverse limestone, the Bell shale, and the Rogers City limestone might account for the cone of depression that apparently existed in the water table in the shallower Traverse limestone.

Corrective Measures

Correction of the Posen water supply problem on an individual basis would be next to impossible. The small-size lots and the innumerable sources of contamination would make adequate isolation of wells virtually impossible to achieve. From a practical standpoint, isolation is meaningless anyway, because of the lack of natural purification as the water travels through the limestone.

It appears that the best solution is the construction of a municipal water supply. Great care would be needed to select the proper location for any municipal wells. First consideration would probably be given to the area on the south side of the village. Construction details would need considerable study and careful design. The village officials have had an engineering study made and a report prepared, but at the moment have not progressed much further. Any project would be quite costly because of the rock excavation necessary to construct the distribution system.

In the current session of the Michigan legislature a bill has been introduced to control construction of wells. The bill provides for the licensing of well drillers by the state health commissioner and calls for permits before wells are drilled.

Summary

An outbreak of infectious hepatitis occurred with epidemiological studies indicating that the first sixteen cases were water borne. Successive cases broke out south of the location of the start of the disease and continued toward the center of the village, where the progress of the disease was sharply curtailed.

The pattern of the disease conformed to a developed theory of the hydrology of the area. The virus apparently was introduced into the ground water through septic tank effluent on the north side of the community. The melting snow and spring rains then flushed the virus down through fractures in the limestone to the water table, where it spread out laterally. It moved southward down a cone of depression to the north central part of town, infecting wells along the way. After reaching the low point in the cone of depression, the virus could travel no farther, as the ground water gradient sloped upward in all directions from the center of town. This could, in part, account for the rather sudden decrease in the number of cases south of the center of the village.

Acknowledgments

The author wishes to thank Norman Papsdorf, San. Engr., Michigan Dept. of Health, for his field study, and L. David Johnson, hydrogeologist, Geological Survey Div., Michigan Dept. of Conservation, for his assistance in evaluating the hydrology of the area.

Prevention of Water Source Contamination

Paul Bolton

A paper presented on Jun. 6, 1961, at the Annual Conference, Detroit, Mich., by Paul Bolton, San. Engr., Henningson, Durham & Richardson, Inc., Omaha, Neb.

THE necessity of preventing the contamination of water resources has been recognized since the discovery of infectious bacteria. Many years ago, the increasing incidence of waterborne epidemics and the many deaths from contamination of water supplies alerted the general public to the hazards of bacterial contamination. Recent water pollution with complex compounds that result in tastes and odors has helped to obtain public support for the control of waste products.

More people and more complex living make contamination control increasingly difficult. New products to ease household drudgeries, to control parasites, to make war, and to perform other functions bring new sources of contamination. This contamination is as hazardous as the products themselves are beneficial. For example, the use of DDT and other chemicals for pest control was accepted without question until the detrimental effects on water supplies became apparent through extensive fish kills. Readily discernible manifestations like this have illustrated the effect on water resources of urbanization, the tremendous increase in water use, and the universal acceptance of water as a means of transporting waste products. It has recently been accepted that water cycles must be as carefully controlled and protected as the biological cycle if man is to continue to live happily. The degradation of waters by the waste products of civilization has long been recognized, but until recently, the availability of alternative sources has served as an excuse to postpone attempts at large-scale corrective and preventive programs.

Widening of Scope

In a basic course in public health engineering, the production of safe water supplies, three considerations are dealt with: location, construction, and operation. Only by widening the scope of these considerations are they applicable to today's situation.

The location of a source of supply, which years ago may have required a limited study of the geological formations, the direction of movement of the underground waters, and hydrologic studies, may now require intensive studies of the formations, water movement, and hydrology of many square miles. More habitation in the drainage area has made these wider studies necessary. The immensity of such a study can be realized when all the sources of water in the Mississippi Valley and all the sources of wastes in the same tremendous watershed are considered. The location of an underground source for large quantities of water in a state such as Nebraska, which has large ground water reserves, involves a study of a tremendous area to determine the

effect of heavy production, recharge capabilities, and the possibility of drawing contamination into the natural storage basins.

Construction encompasses all the necessary preventive measures to avoid or remove water contamination between source and delivery to the consumer. It includes using the latest treatment processes and eliminating cross connections in the plumbing systems of individual houses.

Operation involves a preventive maintenance program for all equipment to keep it in peak operating condition at all times. This program includes preventing contamination from entering the source, the treatment facilities, or the distribution system. Such a preventive program is accomplished by the operator, the improvement of his knowledge and abilities, the use of safe laboratory techniques, and a monitoring system not only within the facilities directly concerned, but interconnected with other similar facilities in the area of common influence.

The broader scope required in basic public health engineering illustrates the effects of increasing population and living complexity. The increasing cases of contamination also show these effects.

Contamination Questionnaire

To gather a list of such contamination cases, the author sought the help of authorities in USPHS and state health and water pollution boards. Along with the requests for assistance, the author sent questionnaires to direct the answers into the area of contamination of water reserves and to avoid reference to the overall problem of stream and lake pollution. The inquiry assured all who wished to help that their replies would be handled in strict confidence. This encouraged respondents to report individual occurrences freely. Respondents were also assured that no individual case would be pinpointed, and that no confidential information would be made public.

The replies from 36 states and USPHS pointed up the need for an adequate preventive program. The response was beyond expectation. If the responses were compiled, the effect of expanding civilization on water resources would be dramatically documented.

It was interesting to note that all the replies were based on relatively recent cases of contamination, occurring since the need for proper location, construction, and operation of water supplies has been recognized. The old, widely familiar cases were not mentioned. The various answers were not suited to statistical analysis, as they ranged from "no cases within the last reasonable period of years" to "literally thousands of instances." Of contaminated surface supplies, 64 cases were reported, for an average of 1.8 instances for each state reporting. Of contaminated ground water supplies, 242 cases were reported, or 6.7 instances for each state reporting. The number of contaminated ground water sources reported is considerably less than the number that actually occurred in recent years, as some states reported having experienced too many instances to itemize. A complete list of privately owned supplies that were contaminated would add thousands of cases to the list.

Generally, the contaminants of ground water are the same as the contaminants of surface supplies. With both ground and surface sources, contamination is caused by materials or wastes in the wrong place. Minor pre-

ventive measures could have avoided some contamination problems, but with others, years of work in correlating causes and effects, coupled with good luck, are necessary to eliminate dangerous conditions.

Discussion of Cases

An examination of the list of contaminants (Table 1) sets them apart from the usual causes of pollution and classifies them as hazards resulting from civilization.

Of the bacterial cases of contamination reported, ten resulted in outbreaks of disease. Typhoid was one of the diseases.

A discussion of each contaminant would exceed the space limits of this article, but the reader's consideration of each one should make him realize the necessity to change from a curative program in water contamination to a complete and comprehensive preventive program. A discussion of a few items on the list should establish this necessity.

Cases of Surface Water Contamination

Although the removal of turbidity from raw surface supplies has long been practiced in water treatment plants, emergency measures necessitated by excavation in the catchment area illustrate the importance of preventive contamination control. An increase of turbidity from manmade excavations and normal rainfall or floods may develop anywhere, as heavy construction is expanding into undeveloped locations. The health of the community is jeopardized when an alternate source or emergency treatment measure must be developed. Unfortunately, a disagreeable water will cause the consumer to seek another source even if its bacterial or chemical safety is unknown.

The control of manmade turbidity from excavation on a catchment area seems simple at first. The more it is studied, however, the more involved it can become, depending on the local situation. A small construction project may be scheduled so that the water treatment facilities can cope with the added load whether precipitation is

TABLE 1

Sources of Contamination

Surface Water Contaminants	
Acid mine drainage	Human wastes
Algae blooms	Insecticides
Ammonia	Milk from truck accident
Arsenicals	Nitrates in treated sewage
Bacteria	Oil field brines
Carbohydrates	Oil refinery wastes
Chromium, other heavy metals	Organic wastes
Cross connection to nonpotable supply	Orthonitrochlorobenzene
Cyanide	Petrochemical wastes
Detergents	Phenols
Diesel fuel	Phosphate
Ether	Radioactivity
Fluorides	Silt
High-temperature heat exchanger wastes	Toxic algae
	Trinitrotoluene

Ground Water Contaminants	
Acid mine wastes	Flood waters
Alpha picoline	Garbage
Aluminum sulfate	Gasoline
Bacteria	Nitrates
Beryllium	Organic wells
Bicarbonates	Petrochemical wastes
Brine intrusion	Phenols
Cannery wastes	Rainfall in crevice rock area
Chromium	Salt for deicing highways
Circus offal	Salt from sea water
Contaminated fill dirt near supply	Salt from zeolite regeneration wastes
Cross flow from perforated underground aquifers	Surface waters
Cyanide	Sewage wells
Detergents	Sulfates
Dissolved oxygen	

heavy or not. If a large project is involved, such as a dam or a highway, scheduling of the project may affect its cost, making it cheaper to develop an emergency source or to install emergency treatment than to schedule the project to cause less turbidity in the supply. If the treatment facilities are inadequate in the first place, such occurrences can serve as a pretext for procuring proper treatment processes. It is most important to recognize the need for adequate preventive measures and to refer the project to people trained in this field so they can help direct it during initial planning.

Algal toxins present more difficult problems. When dead animals and birds were observed around lakes, early research isolated the botulinum organism in dead ducks. Researchers were led to believe the organism was growing or at least surviving in lake shores or bottom muds. As the deaths recurred, they were correlated with the algal blooms that appeared in certain seasons. Injections of the algal solutions into test animals caused death in minutes. One researcher retained the algae in a frozen form for several years with no apparent decrease in its potency. The toxin passed through a membrane filter with the same deadly qualities. Apparently, the effect of treatment processes on such a toxin is still unknown. Research and development on both preventive and curative programs for such toxic materials are necessary.

Cases of Ground Water Contamination

The reporting of contamination due to the proximity of a circus to a well (Table 1) reminded the author of a request for assistance in determining the minimum distance permissible between a circus and a well. To determine this distance, a sanitary survey was made of the local area, of the construction of the well, and of subsoil conditions. In those areas of the United States where livestock are raised, sanitary engineers are familiar with the bacterial contamination of water supplies from animal offal. A concentrated source of waste, however, such as a stock pen or a circus, requires considerably more distance from a well than a pasture area.

One case reported was caused by the flooding of a river. The river overflow covered the area occupied by the well field. The water produced by the wells was high in iron, and required treatment for its removal. The flood inundation by the river not only contaminated the well field bacteriologically, but carried dissolved oxygen into the underground aquifer. The iron was oxidized to the ferric form, causing difficulty in the iron-removal processes.

Another well was idled because several thousand gallons of gasoline leaked from a storage tank and seeped into the well. Salvaging the well required drilling a system of perimeter wells around the source of the contamination and pumping water from the natural reservoir to eliminate the gasoline.

Frequent Contamination Causes

As the cases of contamination reported were reviewed, the most frequent hazards to water resources began to emerge. This cannot be statistically established, as the number of random samples collected by the questionnaire is relatively small. A more detailed, broader range of sampling would be required to establish the frequency of these hazards.

Causes of Ground Water Contamination

The promiscuous storage of wastes on ground surface is one of the most frequent causes of ground water contamination. The storage of chemical, organic, and bacterially contaminated wastes too near a well field or above a water-bearing formation was repeatedly reported. Storing salt from freight car icing or regeneration salts from zeolite softeners has caused localized saline contaminations of underground waters.

Another repeated cause of contamination of ground water is the use of wells for disposing of wastes into the ground. This contamination can spread broadly, owing to improperly constructed and controlled deep-intrusion wells, and to geological faults, that allow cross contamination of different aquifers containing organic, chemical, and bacterial wastes.

An aquifer can free itself of contaminants by dilution once the source that recharges it is decontaminated. The controlling factor is time: by now, some aquifers will not be usable for many years.

Causes of Surface Water Contamination

The typical causes of surface water contamination appear to be those that happen suddenly, or those that gradually build up and strike suddenly. A slug of contamination can be far more devastating than a constant flow of known amounts, as the water superintendent has no warning that it is coming. Undiscernible toxic materials may pass through a treatment plant and on to the consumer. The only defense is a sanitary survey of the watershed above the intake coupled with frequent analyses for wastes that may be accidentally discharged, but this practice relies too much on probability to be entirely effective.

With present techniques, it is possible to protect surface waters. Better control of impoundment areas and positive prevention of the discharge of chemical slugs will greatly reduce the number of hazards. Most intermittent discharges of industrial wastes could be controlled even when equipment fails, if the probability of such failure is taken into account.

Floods bringing torrents of turbid or polluted waters over the countryside, or earthquakes fracturing geological formations and permitting waters of varying characteristics to mingle, can be coped with only if the water utility involved can afford the necessary actions. Costs of corrective structures must be balanced against increased treatment costs. As water supply problems become more critical, more accommodation will have to be made for natural disasters no matter how much money is required. One such measure is adequate treatment of the sewage and wastes in the drainage basins feeding flood plains. This will protect the health of the consumers, which is the primary consideration.

Need for Anticipation of Problems

Improvements or progress in water management may give rise to new problems either anticipated or unforeseen. The softening of water, for example, causes a waste-disposal problem; a well nitrified sewage effluent encourages algal growths in surface waters. The beneficial or deleterious effects that chemicals, either in the natural state or added to water supplies through waste products, may have on consumers' health must be anticipated.

Many people interested in water supply have been concerned over the last 20–30 years about the relatively static situation in the water treatment field. Too many of the innovations and advancements in water treatment have been forced by local situations. Too few have used research and development to anticipate problems. Thus these innovations and improvements have seemed to lag behind requirements. Free-residual chlorination, for instance, was developed through the attempt of a water treatment plant to cope with improperly treated sewage. Other problems, such as accidental releases of cyanide, toxic metals, insecticides, and weed killers, continue to plague the water superintendent. The widespread use of household detergents has helped call attention to the need for preventing the introduction of such chemicals into water resources, or for developing treatment methods that will protect the consumer. If problems were anticipated, action would be taken before large areas of subsoil are so saturated with detergents that water taken from the subsoil foams.

National Master Plan

A master plan for preventing the contamination of water resources on a nationwide basis would be similar to any such plan for a city, town, or hamlet. An attempt to develop a source of adequate quantity and quality in a given locality might cost more per capita than it would cost on a national scale, but the immediate need for water forces the local residents to develop their own source.

A few of the elements necessary for a nationwide master plan for preventing the contamination of underground resources are:

1. *Laws, rules, and regulations.* Laws, rules, and regulations should be uniform and equitable in their application. They should provide necessary authority to the personnel charged with protecting water supplies from contamination. A law is not enforceable, however, if it has no public acceptance. The laws, rules, or regulations should have to be enforced only on the few people who refuse to comply even after the reasons for the laws have been fully explained.

2. *Personnel.* The number of people working in the water supply field should be increased, and so should their capabilities. The multiplying water supply problems make the need for top scientific and technical personnel acute. In addition to technical capabilities, job ability, tact, and public relations awareness are important qualifications for water supply workers. The ability to explain to the public the reasons for laws, rules, and regulations establishes a firmer foundation for contamination control than the statutes themselves.

Only through geological analysis can the saturation of the earth's surface with wastes, and its effect on the natural water stored in basins or flowing aquifers, be understood. As the water from the surface recharges the underground resources, the quality of the stored water is changed according to the recharge water. In most percolation areas, natural soil and biological activity oxidize waste products and destroy bacteria. Chemically stable wastes in solution, however, are not affected by these processes. As the volume of wastes increases, the need for water quality geologists will become more acute.

3. *Well-drilling codes.* The regulation of the location, construction, op-

eration, and abandonment of wells in accordance with proper standards probably controls the contamination of underground waters more than does any other practice. The regulation of waste disposal and intrusion wells is equally necessary. Fortunately, it is frequently more expensive and difficult to treat a waste to discharge into underground formations than it is to discharge it to streams or rivers.

4. *Plumbing codes.* The production of a safe water is of little value if it is recontaminated prior to delivery to the consumer. The outbreaks of illness and deaths resulting from faulty plumbing indicate the need for sound plumbing practices in all installations.

Preventive measures in plumbing eliminate cross connections that may allow unsafe substances to backflow into underground aquifers through wells or to discharge to surface supplies without warning.

5. *Standards.* Standards are, in the author's opinion, one of the most important tools in any preventive program. Usable standards provide norms representative of experiences based on all background information available. The circumstances connected with the contamination of a well field by circus offal or with the contamination of a large underground water-producing aquifer by an oxidation pond provide valuable background information. If each community must learn the hard way, with perhaps disastrous results, lack of these standards borders on the criminal.

Standards are developed in many ways. Presented with the information that 0.5 ppm of cyanide in a complex plating waste killed game fish in the eastern United States, although 10 ppm cyanide was present in a stream in the West without killing the fish, an investigator might be challenged to begin a study of the synergistic effects of the chemical balance of natural waters as well as a study of the waters when combined with treated wastes. This investigator must depend on an exchange of information to begin his work. For his work to be useful, others must learn about it.

6. *New product control.* Adequate controls should be placed on the release of new products if they can in any way contaminate water resources. Consideration should be given to the extensiveness of their use as it affects surface supplies through runoff or percolation. The research chemist who develops the compound is the proper person to develop countermeasures to use if disastrous results should accompany promiscuous use of the compound. This may be considered a harsh measure, but anyone who has seen the complete annihilation of the biota of a stream used as a source of water supply does not want it to happen again. This is particularly true when a new product is involved and its effect on humans can only be estimated by the effect on aquatic life.

7. *Research and development.* A research and development program should be constantly maintained on every aspect of water treatment. With many sources, water treatment begins at the sewer outlet; the entire field of water and wastewater treatment, therefore, should be considered and studied with the same ultimate aims in mind.

The protection of human health is the primary purpose for the treatment of sewage and industrial wastes. In many instances, the parameters for treatment facility design aim to protect stream biota; the primary aim has been relegated to the background. This trend is reversing, however, as

chemical pollution and its unknown effects are being studied more closely. A nationwide research and development program should, of course, be properly coordinated to avoid duplication except on those subjects in which competition is beneficial.

The unknown effects of the nitrogenous materials in animal wastes, or of the nitrates in fertilizers, for example, might require further research. It is an accepted fact that high nitrates in well water constitute a hazard to infants, but the source of the nitrates is debatable. One paper on the medical aspects of the subject indicates that the digestive processes reduce the nitrate to nitrite, and it is probably the nitrite that interfers with the oxygen absorption in the blood.

Until research can catalog all the effects of water-borne waste products on human health, raw-water sources should be of the highest quality possible, with the natural formulation balanced to enhance the consumers' health and the necessary treatment and disinfection procedures employed.

8. *Teamwork.* Probably the greatest requirement for preventing the contamination of water resources is the teamwork of all people interested in water management. The availability, quality, distribution, and uses of water cannot be segregated, but must be studied integrally.

Only if scientists and technical people working in their narrow interests recognize the other areas of the water management program can a master plan emerge.

Conclusion

It is hoped that the generalizations in this article will help keep the spotlight on the need for a concentrated effort to protect man's most vital natural resource. The preservation of waters in a potable state is imperative if the United States is to continue to be a healthy nation blessed with a balanced economy. A fair, equitable, unselfish, and well adjusted water management master plan should be able to change the present curative measures to an easily managed preventive program.

Acknowledgment

The assistance of the state health and water pollution control agencies and USPHS is gratefully acknowledged.

Peak Demands in Residential Areas

Jerome B. Wolff

A paper presented on Jun. 8, 1961, at the Annual Conference, Detroit, Mich., by Jerome B. Wolff, Asst. Director of Public Works, Baltimore County, Md., and Research Assoc., Johns Hopkins Univ., Baltimore, Md.

IN January 1959, the Department of Sanitary Engineering and Water Resources of Johns Hopkins University undertook a research project on peak water usage in residential areas. This project was sponsored jointly by Baltimore County, Baltimore City, the Maryland Health Dept., and the Federal Housing Administration (FHA). More than 2 years have passed since the inception of the project, and a considerable amount of new and valuable information has been obtained.

This article will describe some of the accomplishments of the first 2 years of this project and will suggest some possible additional fields of investigation. The primary purposes of this project are to obtain data on and to make an evaluation of maximum hourly demands in residential areas. Attention was also directed to obtaining information on the effect of lawn sprinkling and other large water uses on maximum demands in residential areas.

The design of transmission mains, pumping stations, and storage facilities in water distribution systems is generally based on an analysis of a hydrograph of demand for average and maximum days. Hydrographs of systems serving predominantly residential communities have a pattern generally containing two peak rates of flow. One peak occurs between the hours of 7 AM and 1 PM and the other in the evening between 5 and 9 PM. The time when these peaks occur depends upon the season of the year. In the winter, the maximum hours occur between 7 and 9 AM, and 5–7 PM. During spring, summer, and early fall, when sprinkling demands are imposed, the times of peak occurrence shift to the later morning hours and to 6–9 PM in the evening.

The hydrograph of demands in residential areas varies with: (1) the number of services in the system; (2) seasonal and climatic factors such as temperature, antecedent rainfall conditions (amount and duration of the previous rainfalls), humidity, and cloud cover; (3) the size and age of lots; (4) the number of people on each service; and (5) the number of water-consuming devices in the house. A number of other, less important variables also affect the hydrograph. During protracted dry weather, the evening peak demand rate causes considerable reduction of pressure and depletion of storage in systems serving residential areas.

The investigation clearly corroborates earlier findings that lawn sprinkling is a significant part of the peak loads during summer.[1,2] Inasmuch

as lawn-sprinkling requirements vary with the size of lots, a differentiation of residential areas was made in accordance with lot sizes. Earlier studies [3] have shown that the density of development on the gross acreage of an area has an important bearing on residential water use. Several well defined areas containing the types of housing developments listed in Table 1, therefore, were chosen for study.

Sampling of individual homes in the five strata of housing developments was accomplished during 1959 and 1960. In the 1959 pilot study, 32 recorders were used, and in the 1960 study, more than 100 recorders were used. Group sampling by means of in-line recorders was also accomplished for an R-6 zone (lot sizes of 5,000–7,500 sq ft) which contained 260 homes, and an R-10 zone (lot sizes of 9,000–12,000 sq ft) which contained 188 homes. The sampling in these two strata was performed within the areas monitored by group recorders.

Correlations of Parameters

A number of interesting relations have been found in the study. A plot of hourly demands and the time of day is shown in Fig. 1 for four different types of residential areas. These strata range from group homes to detached dwellings having areas of 1 acre or larger. These hydrographs were developed from data for 13 days in 1959 in which extraordinary demands were considered to result from lawn sprinkling. During the peak hours between 6 and 9 PM, demands range from a rate of 625 gpd per service for group homes to a rate of 5,400 gpd for houses on 1-acre lots. The difference in total volume of use per day per service is especially marked. It varies from 327 gpd for group homes to 2,320 gpd for 1-acre lots.

A comparison of demand rates for various strata during peak hours and maximum days is given in Table 2. From this table it can be seen that the maximum daily rate for the R-40 area is more than seven times that of an R-G (group) area, while the peak hourly rate for an R-40 area is more than eight times as great as that for

TABLE 1

Strata of Study Areas

Zone Designation	Type of Home	Lot Size *sq ft*
R-G	group house	2,000– 2,400
R-6	detached dwelling	5,000– 7,500
R-10	detached dwelling	9,000–12,000
R-20	detached dwelling	15,000–25,000
R-40	detached dwelling	40,000 and more

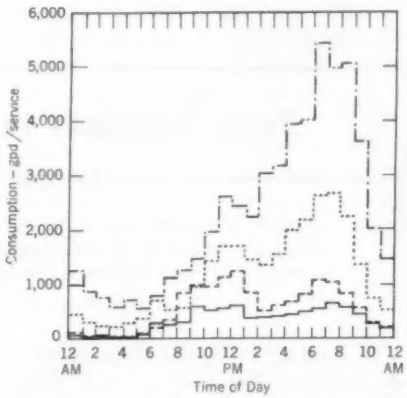


Fig. 1. Consumption by Lot Types

A mean of 13 measured highest days was taken for this chart. The continuous line represents lot type R-G; the broken line, R-10; the dotted line, R-20; the broken and dotted line, R-40.

TABLE 2

Comparison of Maximum Hours and Days

Lot Type	No. of Observations	Max. Day Avg Rate *gpd/service*	Peak Hour *gpd/service*	Ratio of Peak Hour to Max. Day	Ratio of Peak Hour to Avg Day	Max. Day *gpcd*	Avg Day *gpcd*
R-G	63	327	625	1.91:1	3.84:1	93	48
R-6	51	228	605	2.67:1	3.30:1	64	51
R-10	67	556	1,050	1.89:1	4.63:1	163	67
R-20	70	1,170	2,630	2.25:1	7.90:1	278	80
R-40	61	2,320	5,400	2.33:1	10.30:1	564	117

an R-G area. The ratio of peak hour to average day also shows a great diversity between large- and small-lot areas.

In Fig. 2 lot size is plotted against demands for average day, maximum day, and peak hour conditions for the observations shown in Table 2. In Fig. 3 the ratios of the peak hour and the maximum day to average daily demands for different lot sizes are shown. There appears to be a linear relation between lot size and total demand during periods of high sprinkling use. This suggests that the design of distribution systems for residential areas, especially in new, growing communities, might well be related to size of lot rather than to population. The plot of lot size against ratio of peak hour to average day in Fig. 3 shows this ratio to be less than 4:1 for group houses and more than 10:1 for lots of 1 acre or larger.

In a study made by Pineyro [4] in connection with the project on peak water usage in residential areas, a correlation was made between storage requirements in residential areas and population densities of the strata described in Table 1. This study was made to suggest a basis of design for the required quantity of storage for various residential areas with different lot sizes.

In Table 3 the basic data used in the Pineyro study are reproduced. Using the hydrograph of demands presented in Fig. 1 for the individual strata, a relation was developed between storage requirements and population density, assuming a constant pumping rate and applying the procedure developed by Schmid.[5] The resulting equation is

$$S = 388 \times D^{0.172}$$

in which S is storage requirements in gallons per acre, and D, population density in persons per acre.

This relation is shown in Fig. 4. Also shown in this figure are the results of a determination made of the equalizing storage required in large, predominantly residential areas for

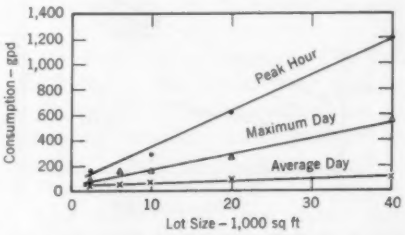


Fig. 2. Lot Size and Consumption

Peak hour consumption for an R-40 area is more than eight times that for an R-G area.

which average land densities were obtained. The Towson, Md., zone (population 60,000), from which all the original data were taken, has an average population of 7.0 persons per acre and a minimum storage requirement of 538 gal/acre. The Eastern Third zone (population in excess of 160,000) has a storage requirement of 503 gal/acre and an average population density of 13.5 people per acre.

An investigation of the relation of maximum hourly and daily consumption rates with unit areas shows that there is little difference in unit demand per acre during peak hours and peak days for the areas in which lots are 0.25–1.0 acre. The R-6 data (lots of 6,000 sq ft) were taken from an old neighborhood (15 years or more), and this accounts for the lower magnitude of demand in this stratum. The group house data are substantially higher than the data for the other house types. This probably shows that intensive use of land for dwellings substantially increases maximum hourly and maximum daily use on an areal basis. In Table 4 the maximum hourly and daily usages for different strata are shown in terms of the demand per acre.

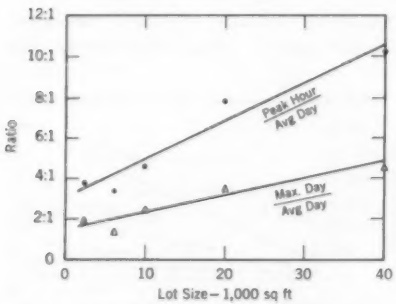


Fig. 3. Lot Size and Peak Hour–Average Day, Maximum Day–Average Day Ratio

The relation between lot size and the demand ratios during periods of high sprinkling use appears to be linear.

TABLE 3

Data Used in Study of Storage Requirements and Population Densities

Lot Type	Approx. Lot Area* *1,000 sq ft*	Estimated Value of Dwelling *$10,000 per unit*	Density	
			Dwelling Units per Acre†	Persons per Acre
R-G	2.4	13.0	9.0	30.6
R-6	6	15.7	4.2	16.8
R-10	10	20.0	3.0	10.50
R-20	20	26.7	1.6	7.46
R-40	40	40.0	0.8	3.33

* Actual approximate lot areas of the dwellings.
† Adjusted by taking into account such areas as streets, public buildings, parks, institutions, and drainage courses.

Household and Lawn-Sprinkling Use

The method of recording water usage in individual households showed only total demands in any period. Because domestic demands were masked by lawn-sprinkling use, it was necessary to develop a method for segregating ordinary household demands from lawn-sprinkling demands. An investigation was made of domestic demands during rainy days when lawn sprinkling was eliminated. Data from a master meter, given in Fig. 5 for an R-6 area containing 260 homes, show the effect of rain on maximum and total demand. One hydrograph represents a hot, dry day, the fifth dry day in a row. The other hydrograph represents a day during which more than 1 in. of rain fell in 24 hr. After examination of hundreds of recordings of water use in individual homes, it was concluded that the difference in volume used on two such days represents the volume of water required for lawn

sprinkling. This method of segregating domestic and sprinkling demands was used in determining a formulation to describe maximum demands.

During peak hourly occurrences on hot summer days when the lawn-sprinking load is exceptionally heavy, ordinary household requirements are obscured by the large sprinkling demands. It is estimated that the sprinkling load can constitute as much as 75 per cent of the total volume for the day and as much as 80 per cent of the peak hourly demand. It was found that segregation of ordinary household demands from lawn-sprinkling demands offered the most practical method of describing peak hourly demand by statistical measures.

The formulation presented below is based on the assumption that ordinary usage of home fixtures follows a binomial distribution. The lawn sprinkling load, which is of longer duration and more uniform, can be added to the usual portion of the demand which has on-off characteristics.

The relation between the number of units on a system and the average unit flow per service was analyzed mathematically, following some of the methods described by Roy B. Hunter,[6] whose work is a landmark in the application of statistical methods to engineering design. Hunter used the classical approach of Bernoulli trials to determine the probability that a number of water-consuming devices on a system would impose simultaneous demands. He assumed that the probability of occurrence of discharge by R fixtures of a total of N fixtures which could discharge at any instant followed a binomial distribution, and that for higher values of N, the Poisson distribution could be used. He assumed that the design requirement for water-consuming devices on a system should not be exceeded more than 1 per cent of the time.

In the present analysis, it is assumed that there is a 2.3 per cent chance that any of the momentary discharges would be exceeded at the upper limit of occurrence. The data developed in this report show that the probability of simultaneous use is somewhat smaller than obtained by Hunter, which is applicable only to ordinary domestic usage.

The assumption was made that lawn-sprinkling usage also follows a binomial distribution. Present results of the project show that the composition of peak demands can be formulated by using two basic parameters.

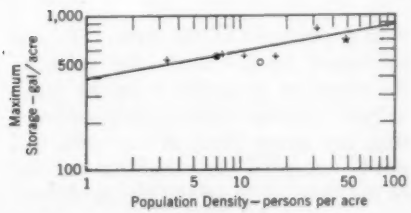


Fig. 4. Storage Requirements as a Function of Population Density

Crosses represent observed data; the dot, calculated storage for Towson zone of service; the circle, calculated storage for Eastern Third zone; and the star, calculated storage for Second zone.

TABLE 4

Maximum Demands and Acreage

Lot Type	Maximum Hour *gpm/acre*	Maximum Day *gpm/acre*
R-G	3.8	2.9
R-6	1.8	0.7
R-10	2.2	1.2
R-20	2.9	1.3
R-40	2.7	1.3

Taking q as the rate of water use, $\bar{q}$ as the average rate of water use in gallons per minute per residential service; n as the number of services, $\bar{n}$ as the average number of services that can be found in simultaneous use during a peak period out of the total number of services, a; the general formula describing the design peak demand, Q, is

$$Q = \bar{n}\bar{q} + 2\sigma_{n\bar{q}},$$

in which $\sigma_{n\bar{q}}$ is the standard deviation of the product $n\bar{q}$, computed as if n and $\bar{q}$ were independent, with the standard deviation of $\bar{q}$ evaluated at $n = \bar{n}$; $\bar{n}$ is given by the product $\bar{n} = ap$, in which a is the total number of services in the system and p is the probability of simultaneous use.

An analysis was first made of ordinary residential demands exclusive of lawn sprinkling in an area having 0.25-acre lots (R-10 area). The R-10 area is demonstrated because it represents a median condition between group house lots and 1-acre lots.

In Fig. 6, the result of the formulation is applied to the data obtained for domestic demands in an R-10 area. In the figure this curve is compared with the curve of demands derived from Hunter's data. It can be seen that, for dwelling units ranging in number from 1 to 1,000, typical domestic demands are considerably less than those derived by Hunter.

A number of factors can account for this result. The upper limit of the Hunter data was necessarily higher than that computed in this study because he assumed that the design requirement would not be exceeded more than 1 per cent of the time. This is equivalent to 2.3 times the value of the standard deviation from the mean values. In this analysis, it is assumed that the upper limit of the data will not be exceeded more than 2.3 per cent of the time, or twice the standard deviation from the mean values. Also, there is a tendency today to provide excess bathroom capacity in homes. This results in powder rooms that are used only on rare occasions. As the Hunter data are based on the existence of water-consuming devices rather

TABLE 5

Commercial Demands

Establishment	Average Demand *gpd*	Rate of Max. Hourly Demand		Hour of Peak Occurrence	Ratio of Max. Hourly Commercial Demand to R-40 Demand*
		gph	*gpd*		
Gasoline service station	636	522	12,500	7–9 PM†	2.3:1
Washmobile‡	9,370	3,140	75,500	11–12 AM	14:1
Laundromat§	3,670	522	12,500	12–1 PM	2.3:1
Commercial laundry‖	3,570	825	19,800	10–12 AM	3.7:1
Motel (110 units)	5,500	762	18,250	8–9 AM	3.4:1
Apartment (22 units)	4,300	486	11,650	5–6 PM	2.2:1

* Lot type R-40 peak hourly demand for single service is 5,400 gpd.
† Erratic, with lower peaks occurring 1–2 PM and 5–7 PM.
‡ Cars washed at rate of 24 per hour. All facilities—steam cleaning of tires, automatic rinsing—available.
§ Ten washers. Open 8 AM–8 PM.
‖ Facilities equivalent to ten washers. Open 8 AM–8 PM.

than on actual use experience, it can be expected that his data are high. For example, new medium-priced homes frequently have two bathrooms or two bathrooms and a powder room. This results in a high fixture count. Finally, it is likely that the Hunter assumption of a major use (as a toilet flush) each 300 sec is high even where the availability of a large number of fixtures enhances the chance of simultaneous use and consequent higher demands.

It is suggested, however, that the Hunter data provide a factor of safety and can appropriately be used in the home for piping design, as the number of water-consuming units in the home continues to increase.

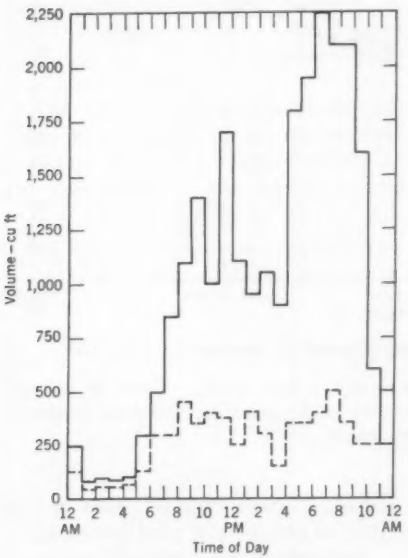


Fig. 5. Rainy-Day and Dry-Day Hydrographs

Hydrographs are for the same 260-home area of R-6 density. The continuous line is for a day without rain; the volume that day was 24,135 cu ft. The broken line is for a rainy day; the volume was 6,885 cu ft. High temperature was the same on both days.

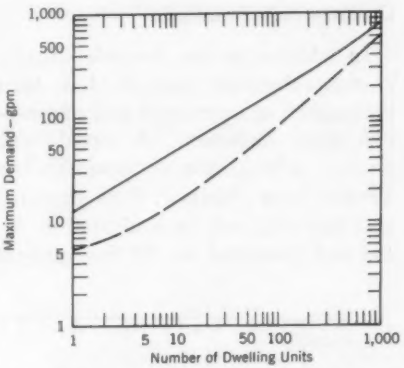


Fig. 6. Peak Hourly Demand and Number of Services for Domestic Supply

The higher curve of domestic supply (flush tank system) was adopted by FHA based on Hunter's data. The lower curve is of domestic demand for an R-10 area according to the author's study.

In Fig. 7, Curve *A*, based on the proposed formulation as applied to an R-10 area, is given. Curve *A* is compared with Curve *B*, based on the Hunter data, which has been used by FHA to determine maximum demands for residential areas of various sizes. Curve *B* is higher than Curve *A* for all values of the total number of services from 10 to 1,000. When sprinkling demands are added to domestic demands, however, the demand curve for the R-10 area (Curve *A'*) is higher than Curve *B* for all demand values greater than 500 gpm. For R-40 areas (1-acre lots) with larger domestic and sprinkling demands, the results will be substantially higher.

Commercial Demands

In addition to the foregoing study, a comprehensive analysis has been undertaken of apartment and commercial water demands. A considerable amount of basic data on these uses has already been obtained; it is expected that this data will be evaluated in detail and presented on the final project report. Knowledge of the characteristics of these demands is essential in evaluating residential uses, as all residential areas require nearby commercial services. Design of distribution systems serving residential areas must take into consideration associated commercial and apartment requirements.

In Fig. 8, the hourly variations in demand during a typical summer day for a single apartment and a single motel unit are compared. The peak hourly demand of an apartment unit is slightly more than three times that of a motel unit. The total daily demand for the apartment unit is 183 gal; that of the motel unit is only 50 gal. The motel peak occurs in the morning, and the hourly peak of the apartment unit occurs between 5 and 6 PM. A graphical comparison is also made in Fig. 9 of the hours of occurrence and magnitude of peaks in four types of commercial establishments.

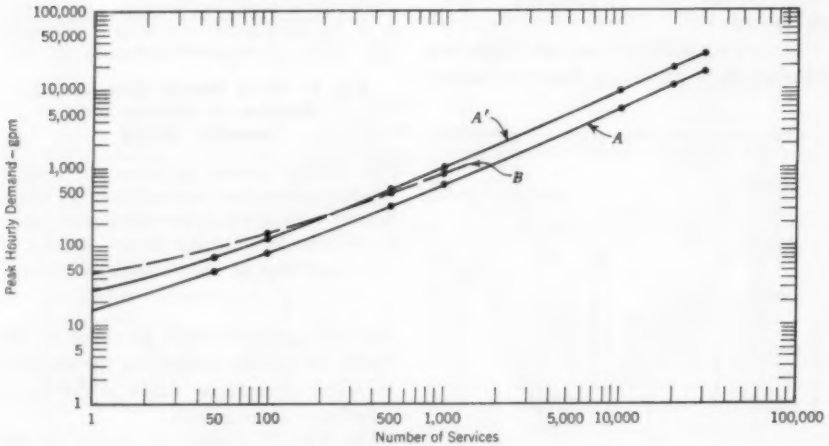


Fig. 7. Total Peak Hourly Demand and Number of Services in R-10 Area

Curve A *is for domestic demands according to the author's study. Curve* B *is based on Hunter's method. Curve* A′ *is for domestic and sprinkling demands based on the author's study.*

In Table 5 are listed the results of a series of tests made of water-using establishments—gasoline service stations, washmobiles, automatic laundries, commercial laundries, motels, and apartments. The information on the hour of occurrence of peak demands indicates that commercial water users occupy a favored position on the daily hydrograph during maximum

demand periods in the summer. For example, the washmobile, laundromat, commercial laundry, and motel all experience peaks between 8 AM and 1 PM; peaks which, although coincident with the secondary peak, do not reach the magnitude of the peak generally experienced in the evenings in residential areas. Many commercial and industrial plants close before 6 PM, and therefore do not contribute to the critical demand period of the day.

Comparative peak hour ratios of commercial demands to demands of a single typical R-40 home on a 1-acre lot are also given in Table 5. A laundromat having ten washers exceeds the R-40 maximum hourly usage by a factor of only 2.3, and so does a gasoline service station.

The motel, which contained 110 units, had a total peak hourly use only 3.4 times that of a single dwelling in an R-40 zone. On an individual rental-unit basis, the motel uses only 3.1 per cent of the maximum hourly demands of an R-40 dwelling.

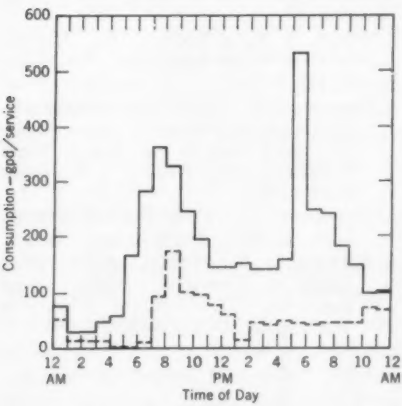


Fig. 8. Hourly Flow in Apartments and Motel Units

The lower, broken line is for motel units with single bathrooms. The continuous line is for apartments with single bathrooms.

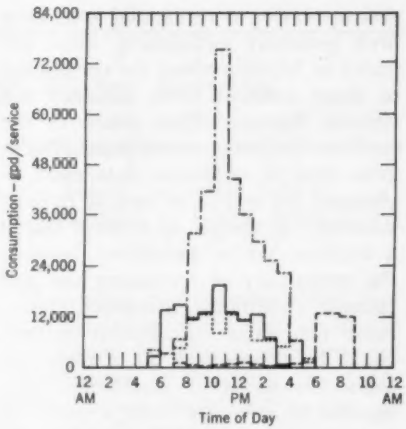


Fig. 9. Hourly Flow in Service Stations, Washmobiles, Laundromats, and Commercial Laundries

The continuous line represents commercial laundries; the broken line, service stations; the dotted line, laundromats; the broken and dotted line, washmobiles.

Conclusions

The average domestic demand appears to increase according to the increase in the economic status of the consumer. The sprinkling demand varies with lot sizes. With respect to the probability of occurrence with various uses, it is presently concluded that the probability of domestic use varies with the number of persons per service. No relation has been found, however, between the number of water-consuming devices in the residence and the frequency of domestic use.

The probability of occurrence of sprinkling demands will vary with season and climate. Although the characteristics of total demand on a

system serving a residential area have been generally established, there remains to be determined the correlation of these demands with seasonal and climatic factors. This phase of the problem is being investigated, but a great deal of additional data must be obtained on which to base a rational solution. It should be evident that if a relation can be discovered between the probability of sprinkling use and climatic conditions, maximum design rates for water distribution systems could be determined on a frequency basis (in terms of conditions being equaled or exceeded over a period of years) similar to the procedure used in storm drainage practice.

The data obtained on commercial demands show that these uses frequently are not imposed on lawn-sprinkling demands. Indeed, commercial uses appear to be favorably situated on the peak day hydrograph of demands.

Inasmuch as it is known that differences in climate and local habits clearly influence maximum water demands in residential areas, it would be very helpful to obtain information on water-using habits of communities in different sections of the country. This can be achieved by broadening the present research program in a coordinated manner with research activities in universities in other areas or with the assistance of additional grants from interested private or federal agencies.

Acknowledgments

The author wishes to acknowledge the work of F. P. Linaweaver Jr. in the residential water use research project, and to acknowledge his helpful suggestions and invaluable assistance in the preparation of this article. The author also wishes to thank Abel Wolman, Prof. Emeritus, and John C. Geyer, Chairman, both of the Dept. of San. Eng. and Water Resources, Johns Hopkins Univ., for their guidance and encouragement; and Acheson J. Duncan, Prof. of Statistics, Johns Hopkins Univ., for his important contributions in guiding the statistical evaluations and analysis for this study.

References

1. FINCH, L. S. The Lawn-sprinkling Load —Indianapolis, Ind. *Jour. AWWA*, 48:364 (Apr. 1956).
2. HENDERSON, A. D. The Lawn-sprinkling Load—Long Island, N.Y. and Levittown, Pa. *Jour. AWWA*, 48:361 (Apr. 1956).
3. WOLFF, J. B. & LOOS, J. F. Analysis of Peak Water Demands. *Pub. Wks.*, 87:111 (1956).
4. PINEYRO, F. J. Equalizing Storage Requirements in Residential Areas. Master's essay, Dept. of San. Eng. & Water Resources, Johns Hopkins Univ., Baltimore (1960).
5. SCHMID, G. G. Peak Demand Storage. *Jour. AWWA*, 48:378 (Apr. 1956).
6. HUNTER, R. B. Methods of Estimating Loads in Plumbing Systems. Rept. BMS 65, US Dept. of Commerce, Washington, D.C. (1940).

Demand Rates for Water Service

William L. Patterson

A paper presented on Jun. 8, 1961, at the Annual Conference, Detroit, Mich., by William L. Patterson, Partner, Black & Veatch, Cons. Engrs., Kansas City, Mo.

IT is accurate to say that a water utility provides its customers with water service; to say merely that a utility provides its customers with water is insufficient. As the costs of this service are met by charging the customers, the customers and the utility will both be treated fairly if charges are made for water service, not just for water. Properly designed demand rates can provide a means of assessing charges that is more fair than block-type rates.

A demand rate for water service is a two-part rate in which charges are based on both the quantity of water the customer uses and the measured maximum rate, or demand, at which he uses the water. With the block-type rate, on the other hand, charges are based only on the quantity of water used. Water demand rates are similar in principle to electricity rates based on energy and demand charges.

If all customers served by a utility used water at a uniform rate throughout the year, the system would be adequate if it were capable of meeting the average annual demands. All use varies from day to day and from hour to hour, however, so it is necessary to provide capacity sufficient to meet the peak demands on the system. The costs of water service are largely dependent on the required capacity of the system.

A demand rate provides a means of accommodating for the effect on service costs caused by differences in customer requirements by assessing an appropriate portion of the service cost on the basis of demand.

The maximum demand of one customer may be six or eight times his average rate of use; the maximum demand of another customer with the same average rate of use may be only twice his average rate. Under a block-type rate, water service charges are the same for both customers because they use equal quantities of water. If charges for water service are to be fairly assessed, the first customer should be charged more than the second because he places a much larger demand on the system.

Acceptance of Demand Rates

Demand rates have been used in determining customer charges in the gas and electric industries for many years. Gas suppliers customarily serve distributing utilities through demand-type rates. Gas-distributing utilities, on the other hand, have found that the costs of demand metering limit the practical application of demand rates to customers with substantial consumption and varied demands. Demand rates are used extensively by electric utilities. Because of the wide range in demands that are imposed on the elec-

tric utility, it is general practice to base charges, for the larger customers at least, on both energy used and demand.

Not until recently have the advantages of demand metering and demand rates been recognized in water supply. Present uses of water have created capacity requirements that are larger than those anticipated 20 years ago. The recent development of suburban communities, with characteristic peak residential demands far in excess of average use because of lawn irrigation, has indicated that both demand and consumption should be recorded to insure that the suburban wholesale customers pay their proper share of service costs.

Metering, in general, is not as advanced in the water supply industry as it is in the electric utility field. Before the 1940's, the costs of water service were not as generally recognized, and the necessity for water service charges fair to the various classes of use was not as evident, as they are today. For several years water utilities operated with a relatively small investment to be derived from rates, many plants having been financed at least in part from public works funds or general municipal funds.

Since World War II, increased water use has required extensive plant expansion at inflated construction costs. The corresponding increases in the costs of water service have necessitated frequent increases in charges to the customers. These higher costs, and increasing recognition of the need for fair distribution of costs, have caused an awareness of the necessity for improved metering in the water supply field.

In the past decade, accurate and reliable equipment for metering demands in water service has been developed, but its cost has limited its practical application to the larger water users. General use of demand metering will not be realized until meters can be manufactured at a cost that will make measurement of the demands of all major customers in a water system economical.

Acceptance of demand metering will also depend on explaining the relationship between demands and costs to management and the customer. The customer must be shown how reduction of peak demands can reduce reserve-plant and associated service costs. Through demand metering and billing, the utility can pass the savings on to the customers who help effect them.

Economic Applicability

To grasp the difference between the application of demand rates and the application of block rates, assume that a water utility has metered water sales of 15,000 mil gal/year and a maximum system demand of 120 mgd. Total plant investment is $20,000,000, on which fixed charges total $1,300,000 per year. Operation and maintenance expenses, omitting customer costs, total $1,030,000. This consists of $400,000 for commodity costs, which are the costs varying directly with the quantity of water sold, and are spent for such things as chemicals and power; and $630,000 for demand or capacity costs, that is, costs generally varying with the demands on the system. The unit commodity cost is 3 cents per 1,000 gal sold. The demand cost, which includes both fixed charges and expenses not included in commodity cost, is approximately $16.10 annually per 1,000 gpd of demand, based on total system demand. Because of diversity among the demands of individual customers,

a factor of 70 per cent can be applied to the unit demand cost, resulting in a cost to each customer of $11.25 annually per 1,000 gpd of individual peak demand. For the demand rate, commodity charges are 3 cents per 1,000 gal, and annual demand charges are $11.25 per 1,000 gpd of measured maximum demand.

A typical block water rate schedule for this utility is shown in Table 1. The rates shown are exclusive of costs of metering, accounting, collecting, and other costs commonly designated as customer costs.

Table 2 shows, for various annual consumption figures, the annual service cost under the block rate compared with the service cost under the demand rate.

Under the block rate billing, charges to a relatively small user, Customer 3, with an annual consumption of 120,000 gal, is $19.20. The average annual rate of consumption by this customer is 333 gpd or 0.23 gpm. As water usage from an ordinary household tap will flow at over 2 gpm, the water demand of this customer is at least ten times the annual average rate of use. If demand metering and rates are applied at the 10:1 ratio of demand to average rate of use, charges would be $41.10, or 214 per cent of the charges under the block rate. On the other hand, if this customer used water at a perfectly uniform rate, charges under the demand rate would be $7.35, or only 38 per cent of the cost under the block rate. The 10:1 ratio of usage is much more likely to occur.

In practice, the design of rates would require consideration of the diversity of use of small customers, and the ratio of group demand to average rate of use would be on the order of 4:1 or 5:1. For small customers, the block rate will recover the costs of service to such customers when considered as a group.

With Customer 9, a large customer using 60 mil gal/year, charges under the block rate would be $6,441. This customer may be an industrial establishment using water around the clock, and the customer may provide internal storage. This customer's ratio of maximum demand to average rate of use may be as low as 2:1, and charges under the demand rate would be $5,550. The annual savings by the use of demand metering would be $891. If, however, the demand ratio of this customer is five times the average rate of use, which could easily be the case, the charges under demand metering would be $11,175. This would be $4,734 more than the charge under the block rate, or over 70 per cent more than the block rate charge.

TABLE 1

Typical Block Water Rate Schedule

Use *1,000 gal/month*	Cost per 1,000 gal ¢
First 25	16
Next 1,175	13
Over 1,200	10

For Customer 7, using 12 mil gal/year, charges under the block rate would be $1,569; under the demand rate, with a ratio of maximum demand to average rate of use of 5:1, charges would be $2,235, a difference of $666 annually. With a 2:1 ratio, demand rate charges would be $1,110, $459 less than charges under the block rate.

The right-hand column in Table 2 shows the ratio of maximum to average demands for which the block rate is designed. These demand ratios are fairly typical and are the result of shaping the block rate to reflect demand ratios expected of customer groups at

given annual consumptions. The ratio varies from 4.2:1 for the customer with the least consumption to 2.5:1 for the largest user shown in this table.

It is evident that the variations in ratios of maximum to average use by the small customer cannot be easily avoided, but that considerable diversity will exist among such customers. Demand metering is neither practical nor justified for such customers, except in cases where a whole community of customers may be metered through a single point of supply, as in a suburban residential community that purchases water wholesale. Both for the wholesale customer and for the water utility, demand metering and rates may be the fairest way of charging for water service.

With a large industrial user, demand metering may also be beneficial to both the customer and the utility. Although annual costs for demand metering may exceed those applicable to conventional meters by approximately $100 per year for a single installation, the savings in costs resulting from demand metering may represent thousands of dollars in annual charges to a large water user. Thus the demand meter installation can be justified economically.

An analysis of customer classification and consumption in cities serving over 100,000 customers indicates a total of 110–300 customers using over 12 mil gal/year. These customers may certainly justify the investment costs of demand metering.

Table 3 shows the total number of customers and the number of customers with consumption of over 12 mil gal/year for five cities. Considerable variation in the number of these large customers is shown in this table. Cities with a predominance of industrial use, usually in the eastern and central locations, will evidently have a larger number of applicable customers than some cities in the West and South.

TABLE 2

Service Costs Under Block and Demand Rates

Customer	Annual Consumption *1,000 gal*	Annual Cost Under Block Rate $	Ratio of Maximum to Average Demands: Annual Cost Under Demand Rate—$						Ratio of Maximum to Average Demands For Which Block Rate is Designed
			1:1	2:1	3:1	4:1	5:1	10.:1	
1	36	5.76	2.21	3.33	4.46	5.58	6.71	12.33	4.2:1
2	72	11.52	4.41	6.66	8.91	11.16	13.41	24.66	4.2:1
3	120	19.20	7.35	11.10	14.85	18.60	22.35	41.10	4.2:1
4	360	55.80	22.05	33.30	44.55	55.80	67.05	123.30	4.0:1
5	1,200	165.00	73.50	111.00	148.50	186.00	223.50	411.00	3.4:1
6	6,000	789.00	367.50	555.00	742.50	930.00	1,117.50	2,055.00	3.3:1
7	12,000	1,569.00	735.00	1,110.00	1,485.00	1,860.00	2,235.00	4,110.00	3.2:1
8	24,000	2,841.00	1,470.00	2,220.00	2,970.00	3,720.00	4,470.00	8,220.00	2.8:1
9	60,000	6,441.00	3,675.00	5,550.00	7,425.00	9,300.00	11,175.00	20,550.00	2.5:1

Other Demand Rates

So far, this discussion of demand rates has been confined to the application of demand metering. Other forms of demand charges may be justified in certain instances. By agreement, a

customer can contract for a given maximum rate of water use. The quantity of water to be taken annually may also be the basis of agreement for water service, but the rate at which water is to be supplied is the basis on which the supplier must finance and build his plant, pipe lines, storage, and pumping facilities.

The maximum rate at which water is to be supplied may be the basis of either a fixed total demand charge or of a unit cost to apply to agreed demand at given periods. The use of a contract demand at a given rate avoids the use of demand meter billing, but requires a rate-controlling device or a demand meter to insure compliance of both parties to a contract agreement. In the use of a contract demand rate, a commodity charge should be made adequate to recover commodity costs that vary with the amount of water used.

Contract demand rates are generally applied only to large wholesale customers such as suburban communities, where seasonal demand requirements may be controlling. Such rates are fair in concept and may have practical application. A properly designed contract demand rate, used with a rate controller, will adequately compensate the water utility for service rendered. But the physical limitation on the maximum rate of water demand may, on occasion, place a significant hardship on the customer. For example, a suburban wholesale customer may require an unusual quantity of water during a fire or during an extremely hot, dry period. Physical limitations on metered use would result in an actual water shortage in the suburban area, even though the supplying utility might have enough capacity to meet the total demand. In this event, the suburban customer would, in all probability, willingly pay the cost of meeting additional demands. Demand metering and rates provide for adequately compensating the supplying utility when unexpected demands are placed on the system, and they avoid the physical limitations on supply, allowing additional sale of water with corresponding opportunity for growth in usage.

Air-conditioning surcharge rates are also a form of demand rate that has received some recognition and acceptance. This type of charge is worth discussing as a separate subject, and has received attention elsewhere.[1, 2]

TABLE 3

Large Water Users in Cities

City	Location	Total Number of Customers	Number of Customers Using Over 12 mil gal/year
1	Central	143,000	300
2	N. Central	126,000	250
3	West	122,000	110
4	South	116,000	120
5	South	117,000	130

Diversity of Demands

In the determination of a unit demand charge, the total demand to be used as a divisor of demand or capacity costs must be applicable to the customer class or customer involved. In rate schedule design, unit demand costs are often determined on customer class, or group simultaneous demand, and may be correctly applied to determine a block-type rate.

If demand metering is to be offered, demands become individual. If these demands are carried throughout a customer group for billing purposes, they would represent the summation of individual, noncoincidental demands. In any such grouping there will be a di-

versity of demands resulting in a simultaneous demand less than the sum of the individual demands. The degree of diversity will vary with the character of respective use, but will be a material factor in any group usage.

Meter-reading surveys of peak usage of large customers have indicated substantial diversity, but further information is needed to arrive at conclusive measures applicable to a given situation. It is entirely probable that a proper diversity factor for an industrial customer group in a major city would be 0.3–0.6, depending on the character of predominant use.

Diversity of demands must be recognized if demand metering is to be fairly applied to water service.

Practical Adequacy of Rates

In many systems, demand rates would not be acceptable to most large customers because the last step in the existing block rate is too low to compensate adequately for the cost of the water sold in that step. This inadequate compensation may be demonstrated by considering the method that was developed in the last decade to allocate costs of service to customer groups. This method is referred to as the base and extra capacity cost method. In it, costs for firm service at optimum load factor are allocated among the various groups or classifications of customers in proportion to total annual water use, and these costs are called base cost.

Base costs include all costs that would be incurred in providing service on a year-round basis at a 100 per cent load factor. Base costs include fixed charges on that part of plant investment that would be necessary if all water were delivered at a uniform average annual rate, as well as on power, chemical, and other nonvariable expenses of system operation. The unit base cost is determined by dividing the total base cost by the total number of units sold. In a block rate structure no water should be sold at less than base cost.

For the system described in Table 2, the base cost of water might be 9 cents per 1,000 gal, indicating that any water sold in the lowest step in the block rate structure (over 1,200,000 gal/month) is being sold at near the perfect load factor cost. If the lowest step were less than 9 cents per 1,000 gal, water would be sold at less than cost. Taking load factor characteristics of large customer use into account, the last step of a block rate should generally be appreciably above base cost.

The application of base cost often shows that charges under the cheaper steps in a block rate do not adequately recover costs of service. If actual demand characteristics of various users are recognized, the ratio in a block rate between the first and last step is typically 2:1. Often the revenue charged under the largest use step is far below that adequate to recover costs for serving large users.

If costs of service are properly determined, there is no reason why the charge for large-use steps of the rate cannot be reduced to promote industry, but the situation should be one of which the utility is fully aware. Correspondingly, if demand metering and demand rates are to be offered, the demand rates should be set to recover service costs, as they should be under block rates.

It is apparent that a block rate has limitations of applicability and fairness when the different rates of use by large and small customers are considered. Demand rates provide for fair

charges to the customer and recovery of costs to the utility.

Metering Equipment

At the present time, demand metering equipment is not widely used in the water supply industry. The Milwaukee water utility has had 2 years of satisfactory experience with demand metering equipment which will operate unattended for 30 days or more and will total the flow through several meters serving one customer. The equipment records on a punched tape the summarized registration of flow for each 15-min interval for all the meters serving the customer. Installation costs have varied from $2,200 for an installation with two services to $4,700 for an installation having four services.[1] Equipment for mechanically analyzing the tapes is available, but because of first cost (about $8,000) Milwaukee has relied on manual analyzing.

Other types of equipment are available that indicate the pattern of water use on a 24-hr, 7-day, or 30-day chart. These must be manually analyzed to determine maximum and average flows. Equipment has been developed that, according to the manufacturers, will record the maximum instantaneous flow occurring between meter readings. Another type of meter will register on one dial the total water consumption in a given period, and on another dial the total of only the flow in excess of a predetermined rate. As a significant market for these types of equipment has not been established, prices are not readily available.

Experience With Demand Rates

Demand rates have been particularly applicable to suburban water systems taking service from the central utility on a wholesale basis. These customers are able to regulate their wholesale demands through the use of storage or other facilities. If controlled operation of the suburban system results in an improved load factor, demand metering would make it possible for the serving utility's savings in fixed investment costs to be passed, in the long run, on to the individual customer. A demand type of rate also offers the large industrial and commercial customers the opportunity and incentive to reduce total water costs by improving load factors through planned water use. Such a rate offers all customers the opportunity to lower water costs by controlled operation of their own water systems, and the serving utility is compensated for its greater plant costs incurred in meeting peak demands.

In connection with a study of water rates for Milwaukee, a special survey of customer demand readings was made during the summer of 1956. The demand data helped to determine cost allocations used in designing a schedule of demand rates for customers using large amounts of water. The schedule provided separate commodity and demand charges for suburban wholesale customers. A similar schedule of charges was offered on an optional basis to large retail industrial and commercial customers. The schedule was adopted by the Milwaukee water utility, and after review and adjustment by the Wisconsin Public Service Commission, became effective May 31, 1957. So far no industrial or commercial customers have been served under the demand rate schedule. It is interesting to note that after the demand rates were adopted, one suburban wholesale customer, by using existing storage facilities and installing a flow-regulating valve, had been able to maintain essentially a uniform de-

mand. It has been estimated that in one year alone this customer, through its program of planned water use, saved $8,000 in water charges.[3] It should be noted that this is not a loss to the serving utility, but a saving in much-needed system facilities that offsets the difference in revenue.

The Kansas City, Mo., Water Department may have been the first water utility to adopt demand metering and rates. It has used them for 12 years for suburban wholesale service. Demand metering was initially installed in 28 services. The meters available at the time of installation required daily changing of charts.[4] Meters now available can provide a month's continuous record without attention.

In 1959, an optional demand rate was designed and adopted by St. Louis. The proposed optional rate was designed to serve large-use customers. No customers have requested service on this demand rate so far. The rate offers some economies to a large-use customer if rate of consumption can be properly regulated. Difficulties of installation and costs of application deter industries from adopting the rates, and so do the demand rates, which are not designed to be sufficiently attractive to large customers.

Conclusion

Demand metering offers the customer the opportunity to reduce water charges by controlling water use while reducing the utility's peak demands and hence its service costs. A demand rate also assures the water utility adequate compensation for the costs incurred in meeting peak demands. With a growing need for conserving plant investment and for awareness of the costs of service, demand rates should receive increasing attention and application. It is of great interest to both the customer and the utility that all pertinent characteristics of water use be fairly taken into account in water rate charges. Demand metering of water can achieve this.

References

1. Committee Report. Trends in Air-Conditioning Use and Regulation. *Jour. AWWA,* 50:75 (Jan. 1958).
2. Gerstein, H. H. Impact of Water Use for Air Conditioning on Chicago's Water System. *Jour. AWWA,* 49:697 (Jun. 1957).
3. Rynders, Arthur. Demand Rates and Metering Equipment at Milwaukee. *Jour. AWWA,* 52:1239 (Oct. 1960).
4. Hatcher, M. P. Distance and Demand Factors in Suburban Water Rates. *Jour. AWWA,* 42:1003 (Nov. 1950).

Recruiting and Keeping Competent Engineering and Management Personnel

Samuel S. Baxter

A paper presented on Jun. 8, 1961, at the Annual Conference, Detroit, Mich., by Samuel S. Baxter, Water Comr. & Chief Engr., Philadelphia, Pa.

THE operation of a water utility is vital to the health and economy of the community it serves. If only for this reason, such an important operation requires able engineering and management personnel and able workers in related sciences. The fact that utility operations are becoming more complex is another reason that able people are needed. In large and important operations of electric, gas, and telephone utilities, recruitment and retention of competent personnel are not left to chance.

Privately owned water utilities are more apt to give attention to the problem of recruiting and keeping competent engineering and management personnel than are publicly owned utilities. This is not to say that men do not find a career in the publicly owned utility or that long service is not the usual thing. But the publicly owned utility usually does not pay much attention to the important personnel problem.

Factors Affecting Personnel Policies

Some existing factors that work against a good policy for management and engineering personnel are: (1) a lack of continuity of management in publicly owned utilities, especially where political factors exist; (2) salary schedules, especially in publicly owned utilities; and (3) a minimum of opportunity for exchange and transfer of personnel from one utility or city to another. Two factors that work in favor of a good personnel policy are continuity of employment and opportunity for public service.

Lack of continuity. When top management in a utility is changed frequently, and especially where such management is politically controlled, the opportunity to establish a long-range policy is difficult. It is not easy under such circumstances to point out a line of advancement for management and engineering personnel at all levels and then deliberately to plan work and assignments in order to make such advancement possible.

Salaries. Present salary schedules probably have more effect on recruitment than on retention of good management and engineering personnel. The last survey by AWWA Committee 4230 M—Compensation of Water Utility Personnel shows that management personnel in water utilities are paid salaries far below those in other utilities, and certainly far below those in industry.[1] The highly capable younger man will be eagerly sought

after by industry and by utilities other than those in the water supply field; consequently, a special effort will be needed to get the man to work in the water field.

This does not necessarily mean that good men are not employed by water utilities. Many good men are attracted to a job for reasons other than salary, and once they are in the field they do not leave readily. But, in general, it can be said that the low salaries paid by water utilities are one reason that they do not get their fair share of good men.

Exchange and transfer. Outside the water field, good management and engineering personnel may find their way to advancement stopped by other men ahead of them, or may find themselves in an age bracket that makes advancement and promotion seem far off. In these fields, there are not too many obstacles to prevent a person from seeking employment with other companies and in other cities where his talents will be recognized and paid for. Generally speaking, this type of transfer is not available in the water utility field, and especially in those water utilities that are publicly owned. Residence requirements alone are often a complete deterrent to exchange or transfer of positions.

Continuity of employment. Continuity of employment is certainly a factor that helps in the retention of management and engineering personnel. It has to be admitted that this factor may cause the retention of poor or mediocre, as well as good or excellent, personnel. It is a fact, however, that, in nearly all instances, water utilities have been in existence for a long time and will continue to operate and grow. Except for top management, almost everyone in the water utility field with any degree of competence can count on keeping his job as long as he wants it.

Public service. The opportunity for public service is a factor that should not be overlooked in obtaining and keeping good management and engineering personnel. As water is such a universally needed and vital product, one in the field is conscious of the fact that he is performing an important public service. This factor appeals to many people and is one of the reasons why many able men stay in the field, despite the comparatively low salaries.

Suggestions for Improvement

Policies for recruitment and retention of management and engineering personnel in the water field may be improved in several ways. These will not necessarily be mentioned in the order of their importance. Their value has been learned from experience, either by practicing them or by noting what has happened when they were not practiced.

Status. The status of professional managerial work in water utilities must be raised. The present Advancement program of AWWA is of help in this regard. The work of manufacturers through advertisements and public information media is also of help. The real work, however, must be done in each community. There is a perfectly ethical and proper way to inform the public of the importance of the water supply industry and its effect on the community. If this is done, it will become apparent to people that the industry is not an impersonal entity but one administered by engineers and managers. These men will have to take part in other community work. If they are able, they will be recognized

not only for their personal abilities but also for the fact that they are managers and professionals in a very important industry.

This kind of recognition and confidence is not gained overnight. It might not come about during the tenure of any one manager. In time, however, the importance of the manager and the engineer in the water utility can be made known, so that younger men will want to come into the field and other men will want to stay in it. Salary scales should be adjusted at least to the levels recommended in the AWWA committee report,[1] and the experience, training, and education standards should be those recommended by the committee. Most well trained men will not want to enter a field in which training, experience, and education standards are not up to their own.

In addition, management and engineering personnel should be recognized and treated as the professionals they are and should be. In business and industry in general, managers, and to a lesser degree engineers, are recognized as people apart from other employees. This does not mean that a class division exists but that recognition is given the men on whom the responsibility rests for profitable management, good operation, and development of new ideas and techniques. These men can be treated as professionals in many ways.

Among the special privileges that may be allowed professional personnel are a degree of freedom in the time they must report to work and time off for professional pursuits, such as attendance at meetings and writing of papers. On the other hand, these men should be required to act as true professionals, devoting to their job all the time required, which in most instances will be more than the regular employee. They should also have service to the public and honesty of purpose as their ideals.

Salaries. Few people other than those who must make top-level decisions are aware that excellent salaries attract excellent men, and that excellent salaries in most instances produce excellent results, for which the value received is greater than the salary. These points are not recognized by most people, particularly when they are applied to public employment.

It will take all types of leadership to get these points across to the public at large. In Philadelphia recently, the mayor stated that the complex operations of a large city deserve the best managerial and professional talent available, and that adequate salaries should be paid to these men. It took one or two false starts and a very thorough report by management consultants, but top management salaries were increased substantially. It may be of interest to know that when the recommendations of the report were applied, the highest salaries went to the two departments, including the water department, that had important managerial and engineering functions to perform.

Transfers. A method should be found to make it possible for good men to move from one utility to another, in order that they may advance their careers. As each community has only one water utility, such a move generally means relocation to another city. When employment is in a governmental organization, the previously noted problem of residence requirement becomes significant. The problem of transfer-

ring from one city to another does not only pertain to the water utility field but to other governmental fields as well. Some means of transferring does exist, but it is not possible in many instances.

Relevant to the problem of transfers is the matter of promotion within or outside a department. Generally speaking, it is good that an organization promote from within. On the other hand, circumstances are often such that an organization needs a transfusion, by which new men are brought in at various levels. This is effective because it keeps men on their toes, men who otherwise might think that promotion and advancement will come automatically and that they do not have to produce too much.

Job rotation. It seems desirable for a utility of any size to rotate men from one job to another, particularly if they show evidence of engineering and managerial ability. Frequently, a man starts work in a particular division of a utility and never gets a chance to work in another division. From the standpoint of top management, there may be a temporary advantage in keeping a man in one particular job and having him obtain all the experience he can. This, however, does not provide the training needed for general management and overall responsibility. Difficult as it may seem at times, and with the prospect of temporary loss of efficiency, it is wise to give men an opportunity to work at various jobs in an organization. Such opportunity may give them the interest to stay in the organization.

Recruitment. Industry has long experience in attracting college graduates, especially those in engineering. Recruiters visit the campuses of engineering schools regularly and use varied methods to attract and recruit the student even before he graduates. Usually, the water utility does little or no recruiting of this kind.

Experience proves that much effort is required to attract even one or two graduates a year. The previously mentioned factors of salary and recognition are real deterrents to water utility recruitment when more glamorous or higher paying jobs are open. On the other hand, the continuity program may succeed, and it is certainly worthwhile to try to attract engineering graduates through talks to student groups, formal recruitment visits, or by any other methods possible.

Reference

1. Committee Report. Survey on Compensation of Water Utility Managers, 1957. *Jour. AWWA*, 51:1473 (Dec. 1959).

Forty Years of AWWA Progress

C. F. Wertz

An address presented on Jun. 5, 1961, at the Annual Conference, Detroit, Mich., by C. F. Wertz, then President, American Water Works Assn., and Director, Dept. of Water & Sewers, Miami, Fla.

THE American Water Works Association has in its 80 years of existence attained great stature. With more than 13,000 members, it is among the better known of the professional groups. But mere numbers mean nothing if there is not stature to our program of services for members and for the general public.

I propose to reminisce a bit and review the progress that AWWA has made during the past 40 years. A great percentage of our members came into the Association during the past 20 years. I have been a member of AWWA for 37 years, and can well remember that during my first 10–15 years the most a member received from the Association was the JOURNAL and a standard or two. In checking back through the records, I found that the AWWA Annual Conference in 1923, the year before I became a member, was at Detroit. It had been there in 1903 also, and was held at that city for the third time in 1961.

The report of the finance committee for the fiscal year ending Mar. 31, 1924, showed an estimated income for the ensuing year of $31,002 and a recommended budget of $30,000. Total membership as of that date was 1,936. The budget approved by the AWWA Board of Directors in January 1961 amounted to $543,810—an increase of 1,800 per cent!

AWWA in 1920

In the year 1920, the membership of AWWA was 1,558. There were three employees in the New York office, including a secretary (part time) at $500 per year, an assistant to the secretary (full time) at $1,200 per year, and an editor (full time) at $1,200 per year. The secretary at the time, James M. Diven, for whom our Diven Medal Award is named, was the father of Jack Diven, the present director of the New York Section. The editor was John M. Goodell, for whom the best paper award was named until last year when it was changed to the AWWA Publications Award. The outgoing president was Carlton E. Davis, general manager of the Philadelphia Suburban Water Co.; the incoming president was Beekman C. Little, later secretary of the Association and one of its Honorary Members.

The Conference that year was held at Montreal. It was at this meeting that a motion was made and carried to form a council on standardization, today known as the Committee on Standardization. George Warren Fuller, for whom the Fuller Award is named, became its first chairman. In 1920, there were two AWWA standards, one on pipe and one on valves and hydrants. The net receipts for the year were $13,128; disbursements, $15,136. It appears that even in those

days they knew how to operate successfully in the red.

There was only one AWWA Division in 1920, which had been known since 1913 as the Chemical and Bacteriological Section. In 1925, a year after the Plant Management and Operation Division was formed, the name of the section was changed to Water Purification Division. In 1929, a third Division, known as Finance and Accounting, was formed.

AWWA in 1930

By 1930, the membership of AWWA had increased to 2,547. Beekman C. Little was secretary, having assumed that office in 1926. The Conference was at St. Louis, Mo. The outgoing president was Jack J. Hinman Jr., professor of sanitary engineering at the University of Iowa; the incoming president, George H. Fenkell, head of the water department at Detroit. By this time, there were four employees in the New York office; there were still only two AWWA standards. The JOURNAL, which had been a bimonthly publication in 1920, was issued monthly, the change having been made in September 1924. The net receipts for the year were $71,185; disbursements, $67,719.

AWWA, 1940–49

By 1940, the number of members had jumped to 3,957. Something important had happened during the previous few years. On the retirement of Beekman C. Little in 1936, the Association received a shot in the arm with the appointment of Harry E. Jordan as its first full-time secretary. Jordan was a human dynamo who brought new life and new activities into the organization. The number of employees in the New York office increased to five. In 1936, there were still two standards, but by 1940 the number had increased to nine. The first manual covering water utility accounting, prepared jointly by AWWA and the Municipal Finance Officers Association, was published in 1938. The 1940 Conference was held at Kansas City, Mo. The outgoing president was J. Arthur Jensen of Minneapolis; the incoming president, Norman J. Howard, head of the water system at Toronto. Income had increased to $99,988, and expenses totaled $88,846.

The first half of the 1940's, the years of World War II, saw little Association growth, but immediately thereafter things began to boom. In the last 5 years of the decade, membership jumped from 5,738 to 8,070, an increase of 40 per cent. Eighteen new standards were published, making a total of 32 as of the beginning of 1950. In addition, other publications became available. By 1950, there were available such books as *The Quest for Pure Water*, by M. N. Baker; *Water Quality and Treatment;* and *Survival and Retirement Experience With Water Works Facilities;* and such manuals as *Distribution System Records.*

In 1949, two new Divisions were formed—the Water Utility Management Division, which absorbed the old Finance and Accounting Division, and the Water Resources Division. The New York office force increased to thirteen. The 1950 Conference was at Philadelphia, where, for the first time in AWWA history, the registration topped the 2,000 mark. The outgoing president was A. P. Black of Gainesville, Fla.; the incoming president, W. Victor Weir of the St. Louis County Water Co. The budget showed an income of $208,273; expenses totaled $199,611.

AWWA, 1950–59

During the 1950's, membership jumped from 8,070 to 12,314, despite a drop in 1959 because of the increase in dues. In 1951, the Association had a new assistant secretary, our present executive secretary, Raymond J. Faust. That year, the Water Distribution Division was formed. In this 10-year period, 30 additional standards were promulgated, and additional manuals and publications became available. The booklet *Story of Water Supply* was published; to date approximately 2,000,000 copies have been sold. "Willing Water" grew up to take his place with "Ready Kilowatt" as a symbol of utility service, and the publication *Willing Water* came into being.

Growth of Sections

As the Association grew, so did the number of its Sections. In 1920, there were 8; by 1930, 18; by 1940, 25; and in 1950, 32 Sections. Today we have 33 Sections, even though four new ones have been formed since 1950. This came about because during the same interval three Sections were discontinued and amalgamated into other Sections. The discontinued Sections were the Four States, Minnesota, and Western Pennsylvania Sections. The two newest Sections, formed in 1960, are the Connecticut and South Dakota Sections.

Control of Activities

From its inception in 1881 until quite recently, the constitutional objective of AWWA was to advance the knowledge of design, construction, operation, and maintenance of water utilities. A review of early JOURNAL issues shows nothing relating to public relations and no discussions about the betterment of those employed in the water utility industry.

As stated before, with the coming of Harry E. Jordan things changed. In 1936, when Jordan became secretary, the president of AWWA, Frank A. Barbour, in his address at the Annual Conference, said:

> In the first place it is necessary, in my opinion, to recognize the necessity of more continuous directive control of activities by the headquarters staff. Past progress has been dependent on voluntary service, and there can be no doubt as to the magnitude of such service still available. But, in order to become a working organization capable of realizing the opportunity open to the Association, an executive staff must be developed which will guarantee a continuity of action not possible by voluntary service. . . .

Although the headquarters staff improved in quality and number, and there was better direction of activities, the bulk of Association work continued to be done by voluntary membership on a host of committees. The staff continued to increase and received another shot in the arm when Raymond Faust became assistant to Harry Jordan. Another advance came in 1960 when Faust as executive secretary hired a very able engineering assistant, David B. Preston, and a standards engineer, James B. Ramsey. Today twenty people are on the New York office force.

Advancement Program

The Advancement Program became a reality in January 1957 with the appointment of an Advancement Committee. A year later, the program was accepted by the Board; shortly thereafter the appointment of James Corey as a staff member really started the program rolling. A reorganization of

the headquarters staff has now put Eric F. Johnson, a 21-year veteran with the Association, in charge of Advancement.

Although the Advancement Program has been with the Association only since 1958, Frank A. Barbour had the idea in 1936 when he said:

> Equally important as technical progress in determining future usefulness of the Association is a recognition of its obligation to add to its constitutional objectives the improvement of municipal service conditions and the betterment of the economic and social status of its operating members.

In 1950, the safety program was started.

Aims and Objectives Committee

In 1959, the Aims and Objectives Committee was formed. It was commissioned to advise the Association of what needed doing during the 1960's. The completion of the committee report [1] is the single greatest accomplishment during my term as president, and I wish to commend and thank all the members of the committee, and, in particular, its hard-working chairman, Fred Eidsness. The report of the committee has been accepted, in principle, by the AWWA Board of Directors, and its recommendations have been implemented by the appointment of two new standing committees, one on education and one on research. These committees and three existing standing committees—Standardization, Professional and Administrative Practice, and Technical Program—have reviewed the recommendations of the thirteen subcommittees of the Aims and Objectives Committee, and their reports are to go to a steering committee already appointed by the AWWA president. The steering committee in turn will employ and work with a management consulting firm to present the final recommendations to the Board on a program and its financing.

Recommendations

I could recommend renewed efforts for making the Advancement Program function as it was intended, but my recommendation is unnecessary. I am sure that the Advancement Committee, together with Raymond Faust and Eric Johnson, has a program under way which will bring about the desired results.

The 160 members of the Aims and Objectives Committee have, in their report, set forth enough things to do to keep the Association busy for some time. My only recommendation here is that the five standing committees, the steering committee, the Board of Directors, and the officers move expeditiously to consummate a program, including its financing, that will provide more services for all members of the Association.

The year 1961 has thus far been a year of transition; ideas and personnel have been regrouped to move forward. I am sure that under AWWA's new president, the Association will move forward even more rapidly.

Reference

1. Committee Report. Survey of AWWA Aims and Objectives. *Jour. AWWA*, 53:517 (May 1961).

AWWA Advancement Program

Joint Discussion

A joint discussion presented on Jun. 8, 1961, at the Annual Conference, Detroit, Mich.

Purpose and Features of Advancement Program

Eric F. Johnson

A paper presented by Eric F. Johnson, Director of Advancement, American Water Works Assn., New York, N.Y.

SINCE the AWWA Advancement Program was adopted by the Board of Directors in 1958, significant progress has been made in a number of its planned activities. As with any new program, however, some of its features have proved not to be worthwhile, and others have led into fields too broad to undertake under existing conditions.

In approaching the development of a revised Advancement Program that would build upon the accomplishments to date, much thought has been given to the basic concept and the basic purpose of Advancement. Actually, everything that AWWA has accomplished, everything that AWWA was organized to accomplish, can be classified as Advancement. Thus, the AWWA Advancement Program is, in fact, no less than the AWWA program as a whole. And the purpose of Advancement is the purpose of AWWA—that is, "improved water service, through water systems self-sustained and adequate to meet the growing needs of each community."

Among the basic requirements for the achievement of this purpose are:

1. *Better methods and materials.* In the first 80 years of its existence, AWWA has devoted its major efforts toward advancing technical achievement in the field. And the establishment of its new standing committee on research, as well as the appointment of a new standards engineer to fortify the efforts of its standardization committee, is indication that the Association does not intend to neglect this phase in the future.

2. *Better managers and operators.* In the past few years there has developed a growing recognition of the need for greater and greater attention to the human requirements for achieving the AWWA purpose. A major question for all industry, it has been said, is: "Where do we stand on manpower for tomorrow?" But in the water utility field the question is even more immediate: "Where do we stand on managers for today?" In this regard, the Advancement Program, in conjunction with the Committee on Professional and Administrative Practice, as well as the new standing committee on education, will face a major challenge.

3. *Higher standards of water quality and water service.* Having achieved the goal of safety, the industry now needs advanced goals, more commensurate with the technical achievements of the field. Thus, a number of task groups are now busy building yardsticks for the measurement of both quality and service as the first step toward setting new goals that will achieve "improved water service."

There is one more element involved if water utilities are to achieve the purpose that AWWA has established for them. That element is money—money in the form of rates adequate to make water utilities self-sustaining, adequate to permit them to provide as good water and as good service as they already have the know-how to provide. Of course, the money is there. The richest nation in the world can certainly afford 2 or 3 cents per capita per day for quality water service. But, to make the money available to water utilities, the public must understand what can be accomplished with it—and must support that accomplishment. In other words, the public must be informed. And informing the public is the second major challenge.

To meet these challenges, the Advancement Program offers a two-pronged attack—an attack on the deficiencies in management education and an attack on the ignorance of the public. The campaign outlined involves effort at all levels of AWWA—the Association providing coordination, communication, and tools; the Sections providing leadership and assistance in the field and a link between the utilities and the Association; and the individual utilities doing the basic job, the most important job, locally. And because the most important job must be done locally, the very first step must be to convince the local utility man that the job not only *can* be done but also *will* be done, and that only if he provides the leadership in getting it done will he profit by it.

Management Education

In its management education efforts to date, the Advancement Program has explored a number of possibilities for establishing programs that will meet the needs of the field. Through these efforts, it has been successful in several sections in establishing management schools of the short-course type that have done a very important job. But, almost always, it has been those who need management training least who have taken advantage of the opportunities offered. The problem of getting to the water utility personnel that need management training most still remains unsolved. It remains unsolved because the people who need the training most are often those least capable of absorbing it and because those who need it most are always those least capable of paying for it. But if better water service is to be provided, if the profession is to be upgraded to a point where it can claim professional status all down the line, these people must be reached.

Under consideration now, as a means not only of reaching those who have little or no training but also of providing for the semitrained and the well trained manager, is a three-phase program.

1. Correspondence Course in Management

Preliminary plans for a basic course in management through a correspondence school are now under consideration. John Murdoch, who, as a member of the AWWA Advancement

Committee, developed this program, presents the details in the following discussion. Here it need only be pointed out that the program is flexible enough to be adapted to the requirements of any water utility man in the field.

2. Seminars and Schools

As a second phase of the management education program, it has been suggested that a series of seminar groups, bringing together the managers of utilities that have similar problems, be organized by the Association as a means of continuing and supplementing the basic training in management. For the largest utilities in the country, a group known as the "Dirty Dozen" has pioneered this type of educational effort for a number of years. And the popularity of question-and-answer sessions at Section meetings has also indicated the value of the participation format. It is felt that, through the efforts of the Association, such seminar groups can be initiated and stimulated to help managers help themselves progress toward "improved water service." Meanwhile, management schools of the type presently being conducted in the Sections also fit into the overall picture as media for the more formal presentations and discussions of the management principles learned in the basic management courses.

3. Advanced Management Courses

As the means of providing continuing education for even the best trained managers in the water utility field today, the Advancement Program is investigating the possibility of setting up courses geared to the needs of the field under the sponsorship of established management schools. In these days of continuing education for all personnel at all levels, it is important that water utility personnel, too, avail themselves of the very best techniques of management.

Public Information

In the field of public information, much has already been done by water utilities, by individual manufacturers, by WSWMA, by the federal government, and by AWWA. But the surface has been little more than scratched. Generally speaking, people still take water supply for granted. Generally speaking, they have no idea of how much is involved in the job of delivering their water to them. Generally speaking, they have even less idea of how much more could be done to give them better water and better service. To meet this challenge, the Advancement Program offers an approach involving six separate but related phases.

1. Publications

a. Willing Water. Although *Willing Water* will continue to be used as a medium for Association and membership information, it is hoped that more and more coverage of local community relations efforts will be developed in its pages. This case history type of report has received the most favorable comment of any feature published. Also, consideration is being given to the publication of a monthly editorial, particularly of the kind that can be useful to the local utility in its relations with the city council or even in its public relations. And, of course, the bulletin will be used in promoting the management education program.

b. Advancement Quarterly. Efforts are now being made to direct the con-

tent of the Advancement Quarterly more specifically at the municipal official, not only to inform him about the needs and problems of water supply but also to get his support in the drive to upgrade the water supply personnel of his community. Also, the possibility of mailing the publication directly to this group by the use of membership mailing lists of other organizations is being explored. There are problems involved in obtaining second-class mailing privileges, but these can be worked out if the other associations are willing to cooperate. At any rate, as there is general dissatisfaction with the present method of bulk distribution, some alternative method of getting the Quarterly to its intended readers will have to be worked out.

c. Bill stuffers. For utilities that mail their bills in envelopes, a simple means of communication with customers is the bill stuffer, such as that used by telephone companies and many other utilities. Even those who do not use envelopes for their bills have occasion to use such stuffers to accompany their customer correspondence, although regular mailings to all customers are, of course, the most effective way of reaching the general public. It is planned to develop a series of four such stuffers promptly, to be sold on subscription to members. The stuffers, dated fall, winter, spring, and summer, will be printed first in *Willing Water,* together with an announcement of their availability and price. Printings can be based on actual subscriptions sold, so there should be no real cost to AWWA for such an operation.

d. Brochures. The development of a series of brochures outlining in detail, for instance, the steps in promoting an improvement project or in obtaining a rate increase has been a part of the Advancement Program ever since it started. As such brochures can provide useful tools for local utilities, it is expected that one or two can be undertaken during the coming months. They, too, will be printed first as articles in *Willing Water* to make them available generally and to take advantage of available staff time.

2. Publicity

a. Monthly releases. At the present time, there is being produced a monthly news release, primarily directed at the trade press, carrying news of Association affairs. It is hoped that this publicity service can be extended to include, at least once every 6 weeks, a release to the wire services and the lay press on some item of general water supply interest. In this field, of course, the National Water Institute (NWI) is also active, but it is felt that news direct from the Association will complement the NWI releases. Such an activity will, of course, be coordinated with the NWI program. In addition to these regular releases, hometown news stories on utility employees who author JOURNAL articles are expected to be mailed out.

b. Section meeting publicity. Many Sections are already handling their own meeting publicity very successfully. It is felt that this job can be done only by the local Section people, but, to assist in this effort, a "how-to-do-it" brochure on the subject is being drawn up from the reported experience of several Section committees. As the Section publicity committees become more familiar with their work, they will undoubtedly want to extend

their activities to publicizing other Section affairs as well.

c. Conference publicity. Present plans call for a major publicity effort for the Annual Conference. In addition to the preparation of releases on all papers presented, on all speakers and presiding officers, on all awardees, and on all other participants, including local committeemen, special attention is to be given to prominent speakers and unusual subjects. Plans for the 1961 Conference included a press party for the members of the local newspaper, radio, TV staffs, and trade press representatives, special press conferences for selected speakers, and a spot news staff to man the press room. The bulk of the publicity work was done in advance at AWWA headquarters, but the professionals on the publicity committee developed additional publicity leads on the scene. Based on experience from the 1961 Conference, plans for future conferences will be amended as necessary, and it is planned to coordinate the publicity effort with the work of the technical program committee.

d. Correspondence stuffers. The first of a series of envelope stuffers to be mailed out with Association correspondence—particularly to nonmembers—is now being used. Such ideas as the challenges of the field, standards of quality water and quality service, and statistics concerning water supply will be included in these publicity pieces.

3. Advertising

a. Mat service. An attempt is being made to work out a satisfactory proposal for making available to members of the Association the series of advertisements originally developed for the Northern Illinois Water Service. In addition, the development of an advertising mat service using the "Willing Water" cartoon is being explored. Arrangements for such services can make available to members of the Association the benefit of advertising agency services at a very low fee.

b. News features. A number of news services, developing small syndicated features like "Believe It or Not, by Ripley," have been offered to the Association as a means of doing low-cost advertising of the water supply industry on a nationwide scale. The features, which are usually picked up by about 150 newspapers throughout the country, cost approximately $500 per insertion. This, of course, means that the advertising space is available at a very low rate, but there is some question as to its real worth. A recommendation concerning this will be made in the near future.

4. Speaker Service

a. Speakers for other organizations. Some effort has been made to place Association speakers on the programs of other organizations. And particularly through the cooperation of WSWMA, there have been some successes. This effort will be continued on a direct correspondence and contact basis with other national associations. And, of course, AWWA's program committee can be helpful in this effort by reciprocal programing of speakers from other organizations. Also, some consideration will be given to the possibility of developing a list of AWWA speakers and subjects that can be printed and distributed to the large number of organizations that might be interested.

b. Section speakers bureaus. Some Sections have already set up more or less formal speakers bureaus. An attempt will be made to get reports from those that have experience and to develop therefrom an outline of a successful technique. But Section Advancement committees, too, will be encouraged to offer their prize speakers to other regional organizations to get the water supply story told.

c. Audio-visual program. To supplement and complement the speakers bureau activities, further efforts in the audio-visual field should be made. It is expected, of course, to use the material already produced: the sound slide film "The Story of Water Supply," the prototype film "Priceless Water," and, now, the WSWMA film "Pennies for Health." But, in addition to this material, it is proposed to develop "how-to-do-it" reports on the use of audio-visuals and the making of a film. Furthermore, the existing list of available films is to be reworked into a list that will be useful for public information presentations. The revised list will be published in an issue of *Willing Water* [August 1961] and eventually reprinted for distribution on request.

d. Facts and ideas for water utility speakers. The previous collection of facts and ideas, published in the December 1953 issue of *Willing Water,* will be brought up to date and published in *Willing Water* again, as well as reprinted for additional distribution.

5. Awards

a. Advancement Award. An effort is being made to work with the Sections in promoting further attention to the Advancement Award. The contest rules were printed in the February 1961 issue of *Willing Water.* They have been reprinted in a small folder for distribution to Section Advancement committees on request. Information received from the Sections indicates that the award competitions are now being extended, but that standardization of the conditions of competion are still required.

In 1961, the first Association-wide competition was conducted, the Griffin (Ga.) Water and Sewage Department winning the gold-plated Willing Water as first prize. A subcommittee of the Advancement Committee judged the section award-winning entries that were on display in the Conference registration area.

b. Achievement Award. The idea of establishing an Achievement Award to be presented to the community in each state or Section that does the best job of improving its water system—a sort of "All America Water City"—is being explored. Thought is being given to the idea of cooperating with one of the civic organizations in its promotion and operation. From experience with the establishment of the Advancement Award, it would appear necessary and desirable to spend the time required to get all the details of such a competition worked out before putting it in the hands of the local Section committees. But an effort will be made to work out the details of this as quickly as possible.

c. Other awards. Other similar awards to water utilities—for instance, for such accomplishments as the best quality water in an area—are to be explored. It is felt that, kept within reasonable bounds, the granting of awards can be a very profitable means of obtaining publicity that will emphasize the "improved service" purpose of AWWA and the industry.

6. Promotion

a. Magazine articles. The promotion of public information on water supply in magazines of general interest has been carried on for a number of years. By providing information and ideas for, and encouragement of, such articles, the Association can reach a greater audience than through almost any other medium. Although the articles inspired and worked on are often not as accurate or as pointed as originally hoped, the effort involved in promoting such published information is well worthwhile. It is proposed to continue and expand current efforts in this field.

b. AWWA. Promotion of AWWA itself will, of course, be a byproduct of many of the activities connected with the public relations effort in general. But it will no doubt be helpful to bear in mind throughout that the promotion of the Association, as such, at every opportunity will be helpful not only to the Association but also to the field as a whole. The better known the Association is, the more appeal membership in it will have. Moreover, the better the Association is known, the more it will be identified as the voice of the industry—and, therefore, the more strength its voice will have in expressing the viewpoint of the water supply field.

Conclusion

This, very briefly, is the program proposed to advance the industry and its personnel in their ability to provide "improved water service." It is a tremendous program—a program that can be carried out only if everyone in the field shares in the effort.

For too long, water utility men have been inclined to look at their job as making the best of what they had. This is an attitude that can only result in poorer and poorer water service. The job of "improved water service" may indeed look too big to tackle, but only if it is tackled will the industry and its personnel achieve their purpose and attain their proper status.

Training Program for Water Utility Managers

John H. Murdoch Jr.

A paper presented by John H. Murdoch Jr., Pres., Eastern Water Company Conference, Ardmore, Pa.

From the very beginning of the AWWA Advancement Program, Committee 1140—Water Utility Advancement and the AWWA Board of Directors recognized that an Association-wide drive should be organized and carried forward for the training of water utility managers. It was officially agreed that, although much attention over the years had been given to schools, short courses, and seminars for operators of treatment plants, only one or two serious projects had been undertaken for the training of the men responsible for entire local water systems. Either they were members of a forgotten class, or it was assumed that they were all adequately trained for their difficult positions, or it was thought that an untrained man could run a water utility—no special skills required. It is now recognized that

there are not enough competent managers to meet the needs of the industry, that the available short courses in management are attended by very small numbers, and that those who do attend are generally the exceptional men who need little further training. It is also recognized that many local managers can afford neither the time nor the money to attend short courses or even AWWA Section meetings and that many never see or examine, let alone study, AWWA literature and manuals.

The fact is that, up to the present time, the Association has been able to do little to train most local managers. Yet on these men rests the responsibility for good or mediocre service. These men can make or break a public water system. Unless they can speak with confidence, courage, and conviction based on a sure knowledge of water supply principles and on skill in the arts of organization and management, local systems will be inadequate. There are too many inadequate systems.

A training program for managers is needed, one that will be within the reach of the many as well as the fortunate few. The program should be sponsored by AWWA, and the Association should reward and give public recognition to successful, diligent students. All the Sections should be able to become active in the program. The course offered should be intensive, broad, and difficult enough; it should require enough concentrated study over a number of months so that the water industry, the general public, and public officials will recognize graduates as men worthy of respect.

Such a program can be started and carried forward successfully, well within the present financial resources of AWWA. A long-established and experienced correspondence school is ready and willing to offer a course or courses in water utility management, if AWWA will sponsor the course and give it energetic and continued backing. The school would expect the Association to share in the work of choosing the subjects to be offered and to have original manuscripts prepared for each subject. The school would then convert the content of the various manuscripts into text books of the type found to be most useful for correspondence school use and would conduct the classes and give examinations.

For purposes of discussion, a course covering nineteen subjects has been prepared (see appendix). Text books are available for twelve of the subjects; AWWA would need to prepare only seven original manuscripts. The idea is to have a course that would offer training in at least the elements of those branches of accounting, finance, engineering, chemistry, bacteriology, organization, and supervision that are involved in water utility construction, operation, and management. Graduates would learn what a water system should be and how to develop one. They would learn what questions to ask and would be able to understand the answers. They would be trained in business management and in the presentation of facts to the public and to governing bodies. In a word, they would be given the training needed to become strong leaders for "improved water service."

APPENDIX

Proposed Subjects for Course in Water Utility Management and Contents of Texts

1. ORGANIZATION OF A WATER SUPPLY SYSTEM *

a. History and importance of public water service
b. Requirements of adequate water supply system
c. Organization of water supply system: ownership; operating personnel
d. General functions of various departments
e. Water utility manager; duties; character and skills.

2. RESPONSIBILITIES OF A WATER SUPPLY SYSTEM *

a. Water utility planning
b. Provision of ample quantity of good water
c. Fire protection
d. Civil defense.

3. LEGAL PROBLEMS OF A WATER SUPPLY SYSTEM *

a. Water rights
b. Contracts
c. Permits
d. Regulations relating to service
e. Actions for damages.

4. PRACTICAL ARITHMETIC

The six parts that make up this series can be divided into two groups. Parts 1, 2, and 3, which form the first group, are very elementary and are directed not only to students who never had a thorough understanding of the basic principles of arithmetic but also to those who have forgotten practically all of what they previously learned. If any student feels that he has a satisfactory knowledge of the basic principles, he may take a special examination. A passing grade on the special examination will excuse him from preparing the examination for the three regular assignments.

The second group comprising the last three parts of the series must be completed by every student who enrolls for this subject. There is an important reason for not allowing any exemptions for these last three parts. The material covered in them includes such topics as significant figures, approximate number computations, and order of operations. It is necessary that every student thoroughly understand this work.

Part 1. Our Number Systems and How Numbers Are Used is the title of the text. It includes chapters on everyday uses of numbers, writing and reading numbers, numbers in measurement, addition, and subtraction.

Part 2. There are four major divisions of this part: multiplication, division, combining basic operations, and Roman numerals.

Part 3. This text is entitled *Fractions and Decimals.* It discusses the four basic arithmetic operations in connection with these kinds of numbers.

Part 4. The following topics are discussed under the title *Square Root, Powers, and Appropriate Numbers:* powers of numbers, square roots of numbers, square roots from table, rounding off numbers, significant figures, reciprocals, and averages.

Part 5. The text deals with measurements of lengths and angles, measurements of areas and volumes, measurement of weight, measurement of time, measurement of temperature, conversion of units, and calculations with denominate numbers.

Part 6. The text is entitled *Ratio and Proportion and Combination of Basic Operations.* It covers the following topics: ratio, per cent, proportion, finding the value of an expression, symbols of

* Text to be prepared; suggested contents listed.

aggregation, and things you should not do in performing calculations.

5. Formulas

These topics are covered: use of symbols, arithmetic signs and their application, equations formed with numbers, equations formed with symbols, operations with the terms of an equation, parenthesis, equations with one unknown term, solutions of simple standard formulas, substitution in formulas, and transformation of formulas.

6. General Properties of Materials

The text explains the basic principles of practical physics. It should not be added to a course that already includes engineering mechanics, hydraulics, pneumatics, and electricity.

Part 1. This part covers theory of matter, specific gravity, motion and force, resultant and components of force, moments and their resultant, center of gravity, deformation and stress, elasticity and resistance of materials, working stresses, simple stresses in structures, riveted joints, and bending stresses.

Part 2. Subjects covered are: pressure in liquids and gases, pumps, effect of energy on matter, energy and work, transformation of energy, heat, magnetism, electricity, effects of electricity, production of electromotive force, and conversion of electrical energy.

7. Elementary Chemistry

The topics covered are: elements, compounds, solutions and their ionization, nonmetallic elements and their compounds, and chemical equations.

8. Practical Geometry and Trigonometry

The text covers such basic concepts as points, lines, and angles. All the common plane and solid figures are discussed and illustrated. Methods are given for finding the areas and volumes of the figures met in practical work. The trigonometry section explains the use of trigonometric tables. It also shows how to solve problems concerning right triangles and oblique triangles. A table of natural sines, cosines, tangents, and cotangents is included in the text.

9. Elements of Fluid Mechanics

Covered are: concepts of fluid pressure, physical properties of liquids, unit pressures in liquids, measurement of unit pressure, resultant pressures on immersed plane surfaces, pressure on curved surfaces, buoyancy, flow of liquids, nature of liquid flow, flow through pipe, uniform flow without minor losses, flow with minor losses, flow of liquids other than water, and measurement of flow of liquids in pipe. The topics covered pertaining to pneumatics are: properties of gases, measurement of pressure of gas, relations between volume and pressure of gas, hydraulic pumps, and pneumatic machines.

10. Modern Supervision

Part 1. How to plan, organize, and control. These topics are covered: five supervisory functions, importance of planning, necessity of cooperation, planning your time, what organizing means, delegation of responsibility with authority, definition of supervisor's authority, three basic types of organization, the six-step procedure for organization, adequate control, four control activities, establishing standards of quality, relationship between quality and quantity, ideal standards, and use of control techniques for measuring performance.

Part 2. How to motivate and coordinate. Specific topics covered are: how to motivate, defining workers' wants, common wants of workers, making the new employee part of your team, high turnover rate expensive, developing initiative, correcting and persuading, framework of the methods of correcting and persuading, the framework as a tool, developing methods of talking, how to coordinate your work and your people, and general summary of the five management functions.

Part 3. How to understand and meet responsibilities. Specific topics covered

are: how to understand responsibilities, changes in attitude toward responsibilities, how to find and state supervisory responsibilities, selecting framework for analyzing, thinking within a framework, developing the ability to meet supervisory responsibilities, sharing responsibilities, and meeting the expectations of the workers.

Part 4. How to train. These topics are covered: functions and responsibilities, emphasize the "how to" approach, the supervisor's overall responsibility, how to select your employees, how to train your employees, the job instruction method of training, broad uses for the job instruction method, how to promote safety and improve housekeeping, two general causes of accidents, handling materials and equipment, how to prevent accidents, keep safety devices in use, and follow up your safety instructions.

Part 5. How to maintain discipline and control cost. Topics covered are: the prevention and control of grievances, reasons why grievances arise, the meaning of discipline, developing a program of discipline, how to control costs, the supervisor's role in cost control, costs which supervisors can control, how to simplify work and improve methods, how to control quality and materials, how to understand and work with your labor agreement, and developing a capable understudy for your job.

11. Economics *

12. Water Supply

Part 1. Planning of water supply systems. Topics covered are: choice of source, distribution system, consumption of water, rainfall, evaporation, percolation and absorption, surface water, streamflow and runoff, river and lake intakes, and flow of wells and springs.

Part 2. Topics covered are: distributing reservoirs, conduits, types and locations of conduits, gravity conduits, canals and flumes, aqueducts, cast-iron pipe, steel pipe, wood-stave pipe, concrete pipe, asbestos-cement pipe, service pipe, valves, meters, hydrants, laying pipe, laying submerged pipe, and bridge crossings.

Part 3. Topics covered are: design of distribution system, planning of system, flow of gravity conduits, flow in simple pressure conduits, design of dead-end distribution system, design of continuous-flow system, displacement pumps, centrifugal pumps, air-lift pumps, and general design of pumping installations.

13. Sanitary Bacteriology

Topics pertaining to: characteristics of bacteria, reproduction, requirements for life, effects of environment on development, bacterial metabolism, physical effects of bacterial action, biochemical effects, bacteria in air, soil, water, and sewage, laboratory practice, apparatus, sterilization, culture media, observation of bacteria, the microscope, staining methods, examination of water for bacteria, and bacterial count.

14. Purification of Water

Part 1. Examination of water. Topics covered are: impurities in water and physical tests of water (temperature, taste and odor, turbidity, and color). Topics pertaining to chemical analyses of water are: hardness, hydrogen ion concentration (alkalinity, and acidity), chlorides and residual chlorine, iron and manganese, and organic matter. Topics pertaining to bacteriological examinations of water are: microscopical examination and standards of USPHS.

Part 2. Topics covered are: screening, sedimentation and coagulation, preparation of chemicals, mixing basins, sedimentation tanks or clarifiers, filtration (mechanical filters and slow sand filters), disinfection (liquid chlorine, calcium hypochlorite, chlorine and ammonia, ultraviolet rays, and ozone), softening (lime-soda process and zeolite process), iron and manganese removal, control of corrosiveness, taste and odor control (copper sulfate, ammonia and chlorine, and activated carbon), control

* International Correspondence School text being prepared.

of fluorine, covering and fencing reservoirs, and typical design of treatment plant.

15. ACCOUNTING FOR WATER SUPPLY SYSTEMS *
   a. Double-entry bookkeeping
   b. Analysis of accounts
   c. Interpretation of trends
   d. Presentation of information.

16. FINANCING WATER SUPPLY SYSTEMS *
   a. Methods of raising capital
   b. Water rates
   c. Accounting procedures
   d. Annual reports.

17. ENGINEERING FOR WATER SUPPLY SYSTEMS *
   a. Standards
   b. Construction problems
   c. Safety in construction.

18. MAINTENANCE OF WATER SUPPLY SYSTEMS *
   a. Complying with standards
   b. Repairs
   c. Safety in making repairs.

19. REPORT WRITING

Part 1. Topics covered are: scope of report writing, importance to business, importance to progress, component parts of reports, personal capacity, personal development, personal equipment, gathering and arranging facts and data, drawing conclusions, preparation of rough drafts, rewriting, attitude toward required reports, selection of subjects, length and form, unity, coherence, and emphasis.

Part 2. Topics covered are: order of parts, examples of introductions, examples of body, paragraph system, headings, the summarizing conclusion, check list, synopsis, typing details, and general suggestions. A report of 2,000–5,000 words is required.

Development of Section Advancement Program

Lewis S. Finch

A paper presented by Lewis S. Finch, Vice-Pres. & Chief Engr., Indianapolis Water Co., Indianapolis, Ind.

Although the activities of the AWWA Advancement Program are originated and guided by the Water Utility Advancement Committee and the director of Advancement, and are coordinated with the program of WSWMA, the Sections of the Association are an integral part of the Advancement team. In fact, much of the success of the Advancement effort depends on the teamwork in the Sections.

Selection of Chairman

The first consideration in the development of a Section Advancement program is the formation of an effective Advancement committee. Its chairman should come from the ranks, for he must have the experience needed to conceive of a program and guide its development.

If the committee is to remain effective, it must have continuity of membership. The chairman should be able to serve for more than just a year. It is difficult to specify the duration of the chairman's term of office, but it should be long enough to give him an opportunity to develop his own program and carry it through before he is replaced. This means that the Section officers in particular, as they pro-

* Text to be prepared; suggested contents listed.

gress toward the chairmanship of the Section, must keep abreast of the operations of the committee, so that they will know which men are best qualified to direct the committee's activities.

The chairman of the Advancement committee must, above all, be energetic, and he must have imagination and be able to follow through his ideas. He must be a person capable of delegating jobs, because one man, obviously, cannot carry on all the activities that should be part of the Advancement committee's efforts. The chairman needs help, and he must be able to make use of the help after he gets it, so that the efforts of his team are stimulated through action.

Another consideration in the selection of a chairman is that of costs. It costs money to go to regional meetings. When a chairman of a Section Advancement committee is to be selected, qualifications other than the person's imagination and energy must be considered: Will he be able to take time off from his job to promote the Advancement effort? Will he have enough money—money that the Section will be unable to provide—to travel to places where he needs to be? Will he be able to participate in regional meetings? Thus, the dollar sign comes into play in the selection of the chairman.

It may be said that it is not fair to hold a good man down because he has less money than another, and perhaps it is not fair. But it must be kept in mind that Advancement does not pertain to any one man but to the water supply industry as a whole. A person must not be made chairman just because he is a good fellow, a good mixer, goes to the AWWA Conference each year, and attends Section meetings. He must be selected because he is the person who will get the job done.

Committee Members

Although it may not be practicable in all Sections or under all circumstances, each member of the Advancement committee, other than the chairman, should be a specialist in his own field. Of course, if a member is a specialist, he cannot be expected to be proficient in dealing with all aspects of a problem. He may need the assistance of another person, or even need a task group of his own to carry out the job for which he is responsible. If, for example, a public information program is needed, the man most qualified to handle it is not necessarily the same man, or the same type of man, best qualified to handle an education program. The specialist for developing a public information program has to be an extrovert who can get an organization to cooperate with him. To do this, he must become acquainted with the top people in the organization. He must make certain that his message filters down from the organization to the people at home. As has been pointed out, Advancement must be a community effort, not just an effort on the part of local utility management. It needs to come also, for example, from state organizations like the League of Women Voters. Local organizations must be educated so that they will support the utility manager if he is making progress or spur him on if he is not.

Membership Promotion

One member of the Section who should definitely be on the Advancement committee is the chairman of the membership promotion committee. While he is participating in the Advancement program, he will have an

opportunity to promote membership throughout the Section. For when people become interested in water supply problems, if they do not become prospects themselves they at least will want to know why their water utility manager is not a member of AWWA. Many water utility managers are not members.

For example, in one great state in the United States, the water utility in the capital city had no members in AWWA. If an Advancement committee had been at work in that city attempting to get people to participate in the Advancement program, the lack of AWWA members would have been discovered, and something might have been done earlier to promote membership there.

Management Courses

The implementation of an effective Advancement program cannot be left solely to the imagination of Section members. Knowledge and training are necessary to develop a program, as pointed out by Eric Johnson in his presentation. It will be proposed to the Water Utility Advancement Committee that an effort be made to have regional or district schools for chairmen, and perhaps even for vice-chairmen, of Section Advancement committees. Of course, if costs of travel are to be minimized, chairmen to be assembled at schools need to be within a limited geographic area.

As Eric Johnson has mentioned, at least two types of effort are needed in Advancement, on the national and local levels—a public information effort and an educational effort. The Association is fortunate that it is going to have a strengthened education committee, which is sure to provide skill and knowledge that the Water Utility Advancement Committee does not have. Members of the committee cannot be specialists in developing details of an educational effort; they should be able, however, to take detailed information developed by others and prevail upon individuals to use it. In regard to the educational effort, mention should again be made that a correspondence course in management is in prospect.

One of the jobs of the Section Advancement committee is to motivate people in its locale to take a management correspondence course. Then, in accordance with the plan of utility men at Austin, Tex., it should be possible to hold monthly or bimonthly local meetings of those taking the course, to give them an opportunity to get together and talk over what they have studied. The more enthusiastic students then would stimulate the ambitions of the others, and the results to be obtained from taking the course would be improved. One weakness of a correspondence course is that students cannot easily discuss what they have learned. This can be remedied if the Advancement committee encourages meetings of those taking a course.

The educational effort should also pertain to those on the upper levels of management. Their interest should be aroused so that they will urge their subordinates to better themselves educationally. The Indiana Advancement Committee has a high-level weekend seminar at Turkey Run State Park, a park to which everyone likes to go in the summer time. Those who attend are urged to take their families and remain for both days. There is a tuition fee; lecturers from Purdue and Indiana University, as well as men from industry, talk on business subjects and on industrial management,

largely in the manner of a round-table discussion.

The attraction of the state park helps motivate people to attend the seminar. The families urge their men to attend, anticipating a pleasant weekend at the park. This is one way of promoting a seminar and increasing attendance.

Another high-level educational program is the one given at Allerton House, maintained in connection with the University of Illinois. It was originally organized and carried on under the sponsorship of the AWWA Illinois Section, largely through the efforts of Thurston E. Larson of the Illinois Water Survey. In 1961, it will be sponsored by both the Illinois and Indiana Sections.

The Indiana Section, in an effort to get the managers of medium-sized utilities interested in the annual Advancement competition, pays the expenses of an employee of a utility that has entered the Advancement contest but has not won. This person is not a representative of the winner of the contest, for the winner has less need of the course than do the losers. On the other hand, there seems to be no point in paying the expenses of one who was not interested enough to enter the contest.

There are many ways for Section Advancement committees to further their programs. An imaginative and trained committee can do much for the Association's Advancement effort.

WSWMA Public Relations Program

Robert F. Orth

A paper presented on Jun. 8, 1961, at the Annual Conference, Detroit, Mich., by Robert F. Orth, Sr. Vice-Pres., Johns-Manville Corp., New York, N.Y.

DURING the past few years, common aims of the American Water Works Association, Water Pollution Control Federation, and Water and Sewage Works Manufacturers Association have resulted in an effective public information program on water supply. Each organization has been able to chart more skillfully its own area of activity through an exchange of information and a determination of its aims and objectives. The programs of all three organizations are needed. Although they come under the heading of Advancement, they are truly public information programs. Through the combined efforts of the three organizations, the American public is becoming educated in, and therefore alerted and sympathetic to, the problems and needs of the water industry.

The manufacturer sees Advancement in two ways: (1) the approach being carried on at the local level, through AWWA Section Advancement committees, and the WPCF program guided by its public relations man; and (2) the approach at the national level, as carried out by the manufacturer's public relations arm, the National Water Institute. The program at the local level activates citizens groups to provide the support needed to alleviate problems in a given area; the national public relations program alerts people to the overall national problem, causing them to look into their local situations.

Of course, the job of Advancement cannot be achieved overnight. But as AWWA, WPCF, and WSWMA programs mount, more and more evidence of their effects will become apparent. The public is now beginning to realize the need for more water facilities; this awareness will become more and more evident.

In many areas, cooperative effort among the three organizations has already had an effect; in many other areas, education of the public is still needed. But the day is in sight when increased water use will be encouraged because the facilities will have been constructed to provide the needed supply. Adequate sewage treatment will have lessened the heavy burden on water treatment facilities, and the American public will be united in an effort to insure their own and their children's well-being.

WSWMA began its public relations program about 5 years ago. By starting slowly and researching its aims and objectives, it was able to build a firm foundation for the program by 1960. A survey in 1959 set it on the course it is now following. The present program was designed with long-range objectives, but, at the same

time, immediate requirements were recognized.

During 1960 and 1961, there was more public discussion of water supply and water pollution control than ever before. WSWMA feels that its program and that of AWWA had a great deal to do with this increased interest. In the summer of 1960, some of the early results of the WSWMA program were shown to AWWA. In December, WSWMA had the opportunity of reviewing its 1960 program with the AWWA Board of Directors; the Board's reaction was very favorable. A brief review of the program may be of interest.

Conference

Months of effort by WSWMA's public relations counsel, working with President Eisenhower's office, plus hard work and able assistance from other groups, finally bore fruit when the National Conference on Water Pollution was held in Washington, D.C., in December 1960. The conference drew citizen leaders and leaders of government and industry to Washington for 3 days of intensive study on the effects of pollution on health and well-being in the United States. This meeting and the followup activity are having an important effect on national legislation concerning water pollution. In addition, widespread publicity of the conference and of pollution in general appeared in newspapers and on radio and television, focusing attention on the problem.

Television Film

Another outstanding achievement was the excellent reception given WSWMA's film "Pennies for Health" by television station managers and program directors. Wherever practical, stations invited local authorities to discuss the situation in their area after the film showing. The film has been seen by more than 2,000,000 people. The number is expected to increase by the end of 1961.

On occasion the film has been loaned to local groups. If it had been released generally in local communities, its chances of success on television might have been damaged. Now that a basis for working with television stations across the country has been established, WSWMA is prepared to offer the film to AWWA for local parent-teachers meetings, civic associations, womens groups, and other organizations.*

A special six-page brochure highlighting the film is also available for distribution. It is designed to tell the story in capsule form, as well as serve as a valuable reminder to the public after it views the film.

Speakers

Another activity enhancing the program has been the public appearances of outstanding speakers from industry and elsewhere. Notable among these appearances was that of Mark Hollis, assistant surgeon general of the United States, on the Arthur Godfrey Show. The appearance was arranged by WSWMA's public relations counsel. A thorough discussion of the problems and solutions of water supply and water pollution control took place during the 55-min program. An estimated 1,250,000 people listened to this show, many of whom do not read

* Requests for the film should be addressed as Director of Advancement, American Water Works Association, 2 Park Avenue, New York 16, N.Y.

newspapers or magazines and can be reached only in this way.

Radio

A series of radio scripts on subjects pertaining to water and water pollution was released to 426 stations coast to coast. One can get an idea of the subject matter of the scripts from some of the titles: "What a Penny-and-a-Half More a Day Can Buy for You," "Plenty of Water Is Still the Best Fire Fighter," and "Enough Water Is Your Responsibility." All subject matter was directed at the public, emphasizing personal responsibility for the solution of water supply problems.

A special radio script service reaches millions of listeners every month. This service has been doubled during 1961. Each month, 12 months a year, these scripts are being sent to 600 radio stations. Messages are light and newsy, but carry the basic water story to millions of people effectively. A survey of women radio commentators at a recent meeting in Washington, D.C., revealed that the material was being received favorably by the experts.

Publications

National magazine and newspaper coverage was an important activity of WSWMA in 1960, resulting in major article pieces in *Look* Magazine and a condensation of an excellent article in *Readers Digest*. Newspaper coverage, directed at 1,700 daily newspapers located in every major center in the United States, had excellent results. In 1960, regular editorial service to small daily and weekly newspapers was also begun. WSWMA plans to have broader and more intensified national coverage of its water story in 1961.

Two 1961 articles "The Worry Over Water," published in *Changing Times*, and "What's the Solution to Pollution?" published in *Junior Scholastic* had a combined circulation of more than 2,000,000. Both these publications reach important opinion bodies. *Junior Scholastic*, for example, is read and studied by approximately 50,000 teachers. In addition, about 1,500,000 pupils use it as a source of information and frequently tell their parents what they found.

On May 14, 1961, a WSWMA report, worked on for many months, was published in *American Weekly*, a newspaper supplement included in 32 major Sunday newspapers read in communities where the water problem is evident. The circulation of *American Weekly* is well over 9,000,000, with a probable readership of 27,000,000. WSWMA worked with the writer, Thomas Fleming, supplying him with material on the subject. His story, "Water, Water, Everywhere," emphasized WSWMA's position that water is plentiful but that shortages are the result of a lack of adequate facilities for storage and distribution.

In a program like WSWMA's, it is important to keep in close contact with magazine writers and editors because of the length of time and amount of work required before publication of material. For example, more than a year ago, work was begun with the editor of *Today's Health* on an article prepared specifically for that publication. The story was published in the August 1961 issue of the magazine.

WSWMA's public relations counsel interested *This Week*, another newspaper supplement, in the water supply story. A newly prepared background memorandum was supplied to the editors of the publication, and a number of meetings were held. As a result, an article is being prepared by the US

Department of Health, Education, and Welfare for the surgeon general's byline. A visit in Washington with the editors of *U.S. News and World Report* and *Nation's Business* brought a good reaction to the story and a possibility that future articles may be developed. WSWMA is keeping in close contact with both publications. Meetings have been held with the editor of *Suburbia Today*, still another newspaper supplement, carried in hundreds of small newspapers in suburban communities throughout the United States. The editor has shown interest in and will review the film "Pennies for Health" as a basis for preparing an article on water supply.

There are many stages to the development of an article for publication in national magazines. Sometimes it takes many months before the proper approach is developed and the article is considered for publication. Every month of the year, WSWMA researches, writes, and releases a special article to 1,700 daily newspapers with a circulation of more than 35,000,000. The material is either placed with one of the wire services or mailed directly to the newspapers. In many instances, the articles are run exactly as written. At other times, the material is used as a basis for a story on the local situation. Editorial acceptance of the material has been increasing month after month.

Because the average worker spends one-third of his life at his job, the plant newspaper or special-interest publication plays an important part in an education and information program. WSWMA is taking advantage of this situation by releasing material twice a year, in the spring and fall, to 3,000 special-interest publications with a combined circulation of more than 40,000,000. Most of these are company employee publications; others are magazines printed by fraternal groups, labor unions, and shopping centers.

Cartoons

An important part of any newspaper is the editorial page, and one of the best-read features is the editorial cartoon. WSWMA's cartoon series, started in 1960, has become an outstanding feature of its public relations program. Cartoons were mailed to newspapers every other month in 1960, with an editorial accompanying them on alternate months. In 1961, six editorials and twelve cartoons are being mailed to 2,000 small daily and weekly newspapers. During 1960, WSWMA's message reached about 2,700,000 readers. During 1961, with twice the number of cartoons available, circulation should be about 24,000,000, better than nine times that of the previous year. In many instances, the newspapers used the editorial material as a basis for discussions of their own local situations.

Brochures

In 1959 and 1960, WSWMA had a great deal of success with its "editorial fact sheet." AWWA members received copies of the 1960 version, "Water, a Matter of Survival—Pollution, a Matter of Health." The 1961 editorial fact sheet is larger, with twenty pages of facts and figures brought up to date. It will be distributed in September 1961 primarily to members of AWWA, WPCF, and WSWMA and to community groups and editors. Probably 30,000–40,000 copies of the new fact sheet will be distributed in 1961.

When background information is requested by editors, writers, and community leaders, there must be avail-

able material they can use to provide them with story leads and much more detailed information than is included in the fact sheet. For this purpose, WSWMA is preparing a "background brochure," which is almost complete. It contains a vast amount of information pertaining to all aspects of the water problem. It has been researched and screened by AWWA and other groups to insure its accuracy. Hundreds of these brochures are expected to reach important editors and opinion makers.

Women's Clubs

WSWMA's public relations counsel has assigned a woman to work with national womens clubs. Steps have been taken to release material to the publications of these organizations and to encourage the use of this material for the discussion sessions at local meetings. Women active in these groups can be a tremendous aid to all those in the water supply industry in supporting plans for expansion or new equipment.

Future Plans

A top editor of a nationally known news magazine stated that "the nation is becoming more and more conscious of the problems of water supply and pollution through the national public relations program now being carried on. . . ." In view of past accomplishments, WSWMA plans to continue its program expansion in the latter part of 1961. The new fact sheet will be distributed, the television film will be made more widely available, monthly cartoon and editorial material will be placed with 2,000 newspapers, and major news stories and radio scripts will be released. Expansion of the other program features mentioned before will also be continued.

Algae and Other Interference Organisms in Water Supplies of California

C. Mervin Palmer

A paper presented on Oct. 26, 1960, at the California Section Meeting, Long Beach, Calif., by C. Mervin Palmer, Biologist, Robert A. Taft San. Eng. Center, USPHS, Cincinnati, Ohio.

CALIFORNIA has difficult problems in arranging for the distribution and use of its water supplies. Droughts, floods, unequal geographic distribution of rainfall, conflicting water rights doctrines, and the necessity for irrigation of large agricultural areas are among the causes of these problems. In addition to surface supplies, large quantities of water are available in extensive underground basins, often with high color, organic, and iron content. Other sources are the snow waters, especially of the Sierra Nevada and the Colorado River, located far from the areas where water is required.

Sources and Development

Virtually all of the precipitation occurs during the winter and early spring, an average of 70 per cent falling during the three winter months. In the extreme northwestern part, rainfall exceeds 100 in. per year, while in the extreme southeastern area rainfall is limited to 3 in. or less per year. Southern California, with more than 50 per cent of the state population, has less than 2 per cent of the stream flow.[1] The extremely arid region in the southeast constitutes approximately 20 per cent of the total area of the state, and 72 per cent of all of the state's waters are in the Sacramento drainage basin with the streams flowing into the Pacific Ocean at San Francisco.

By 1925, the entire summer flow of all accessible streams throughout the state had been put to use. There were no additional waters that could be brought into service except the winter flows that come in huge volumes, filling the channels and frequently flooding the surrounding lands immediately after storms. To be utilized, the water of the winter flows must be stored, and some from wet years must be held over for use in dry years. The annual precipitation varies considerably, with occasional dry periods sometimes extending over a few years.[2]

The Colorado River has become another important source of water for California. It has been described as the Southwest's greatest natural resource. The drainage area for this river covers about 8.3 per cent of the area of the continental United States, and its channel is the second longest in North America.[3]

The Sacramento River and others in California are very important in irrigation schemes, but have had only a limited use for public water supplies. Many streams have an intermittent flow and would require water storage facilities for continuous use. The streams in the redwood area[4] and,

particularly in Southern California,[5] waters from many of the extensive underground channels and basins are used by many of the smaller water supply systems. Much of the water obtained from underground sources is colored red or brown and requires treatment for color removal.

Water from the different sources varies considerably in its physicochemical properties. Snow water from the mountains tends to be soft and very corrosive owing to its content of free dissolved CO_2 and the consequent low pH.[4] Los Angeles aqueduct water has an average of 84 ppm hardness, 116 ppm alkalinity, and a pH of 8.28.[6] In some cities, waters from two or more sources are mixed, which counteracts the extreme characteristics of either one. At San Francisco, the Hetch Hetchy Aqueduct supply from the mountains has been mixed with the harder water from local sources, which raises the pH sufficiently to prevent severe corrosion.[4]

Concern for the control of water appropriation in California was early evident in the appropriation doctrine and the riparian rights doctrine. A state water code was first developed by a water commission in 1913.[7] As needs grew for additional supplies of water to be brought from a distance, works such as the Central Valley Project were initiated.[8] These involved agreements for the use of the water and arrangements for construction of large aqueducts and impoundment and storage reservoirs. The Hetch Hetchy scheme was one of the first large projects in the state, and involved the construction of dams and aqueducts to transport over 200 mgd from O'Shaughnessy Dam on the Tuolumne River in the Sierra Nevada to San Francisco.[9]

Severe droughts, such as that of 1948, helped to demonstrate that water is California's most vital and most limiting resource. The State Water Resources Board was established, and the California Water Plan, truly statewide in scope, was formulated. It provided for all known uses of water.[10] The project has become known as the Delta Pool Concept. It calls for the pooling of the surplus waters of northern California, with the delta as the focal point for collection, and for their diversion to deficient areas in the west and south. It is described as the largest water development project ever conceived.[11]

A few years ago, 61 per cent of the water for public use in California was obtained from streams, lakes, and reservoirs, and 39 per cent from wells and springs, in contrast to 74 and 26 per cent respectively for the United States as a whole.[12] Less than 20 years ago, 77 per cent of the public water supplies of the state got all or a major part of their supply from wells.[13] It is probable that the California figures will approximate those for the United States as the Delta Pool project is developed.

Among the federal agencies active in major water planning and construction in the state are the Bureau of Reclamation, which is concerned with irrigation, and the US Army Corps of Engineers, which is concerned with navigation and flood control.[14] Experiments for increasing the water yield in the Southern California mountains by modifying the land vegetation are an example of still another approach in conserving the water for useful purposes.[15]

Algae in California Waters

Although many of the streams have a high turbidity that would tend to

keep the growth of algae to a minimum, the rapidly increasing numbers of impoundment and storage reservoirs, as well as irrigation ditches and open aqueducts, are providing environments for the abundant growth of both planktonic and attached algae.

Unfortunately, most of the academic work on taxonomy and ecology of algae in California has been limited to marine forms along the coast. Hoppaugh studied the genus *Vaucheria*, the most common fresh-water species in California being *V. sessilis*, *V. geminata*, and *V. terrestris*. Another form, *V. uncinata*, was present in an irrigation canal.[16] Drouet has identified a number of blue-green algae of eastern California.[17] Allen, in his work of about 300 pages, deals with the plankton of the San Joaquin River.[18] *Microspora*, *Nostoc*, *Spirogyra*, and *Zygnema* are listed as the algae abundant in pools of San Diego County.[19]

The algae in lakes and reservoirs of the state have been referred to frequently by people concerned with the quality of water supplies. In Sweetwater Lake in Southern California, *Fragilaria* was the only abundant alga during June, but in July it was joined by *Ceratium* as the dominant form and by *Staurastrum* and *Pediastrum*. In the late summer *Ceratium* remained dominant, while *Anabaena* near the surface and *Oscillatoria* at a depth of 32–45 ft became abundant. The principal algae in early winter included *Stephanodiscus*, *Pediastrum*, and a lesser number of *Fragilaria* and *Ceratium*.[20]

The San Francisco region has a climate cool enough to bring about distinct seasonal changes in the plankton algae of the lakes and reservoirs. Such diatoms as *Synedra*, *Stephanodiscus*, and *Asterionella* predominate during the winter; a mixture of forms, particularly green algae (*Staurastrum*, *Mougeotia*) and flagellate types (*Ceratium*, *Mallomonas*), are prominent during the spring and early summer; the blue-green algae (*Anabaena*, *Aphanizomenon*) often become the dominant group in the late summer and fall.[21]

Problems caused by algae become more critical in Southern California with the higher water temperature, longer hours of sunlight, larger impounding reservoirs, and higher concentration of nutrients in the water. These conditions permit a greater abundance and variety of algal growth and less variation in the kinds that predominate during the different seasons of the year. The most troublesome algae in the Los Angeles reservoirs include *Anabaena*, *Aphanizomenon*, *Ceratium*, *Volvox*, *Synedra*, *Chroococcus*, *Microcystis*, *Asterionella*, *Stephanodiscus*, *Dinobryon*, *Mougeotia*, and *Sphaerozyga*.[22] There are many others, however, that may be abundant and significant, such as *Ankistrodesmus*, *Coelosphaerium*, *Navicula*, *Pandorina*, *Oocystis*, and *Melosira*.[23]

Among the algae that grow attached to the sides and bottom of streams, aqueducts, irrigation canals, and the margins of reservoirs, *Cladophora*, *Chara*,[24] *Phormidium*, and *Vaucheria* are common along with many aquatic flowering plants,[25] such as *Callitriche*, *Juncus*, *Eleocharis*, *Isoetes*,[19] the pond weeds *Potamogeton* and *Zannichellia*, the cattails, tules, the rush *Eleocharis*,[26] *Vallisneria*, *Anacharis*, pond lily, and parrot's feather.[23]

The blooms and lesser growths of phytoplankton, the surface mats of algae, the dense mats of attached algae and water weeds, together with the many types of bacteria, protozoa, and

higher animal forms, all combine to give many problems to those interested in the maintenance of water supplies in California.

Reservoir Problems

It has been reported that the same algae that cause trouble in New England are found causing problems in the Southwest, with a tendency in California for the green algae to be the more bothersome, especially in the late summer.[27] Troubles for which the aquatic growths are responsible include the increase in the organic content of the water, which in turn may clog filters and produce tastes, odors, and coloration, or may serve as nutrients for organisms in the distribution system. Algae also reduce the useful capacity of reservoirs by concentrating at certain depths in the water or along the shallow margins or bottom.

Attached forms may cause the overflow of open aqueducts by reducing the capacity of the water channel. Fragments of the larger masses often break loose and clog the screens at the outlet structures.[24] The appearance of large masses of growth is objectionable also to people with cottages along the shores, and may interfere with various recreational uses of lakes and reservoirs. The accumulation of large quantities of decomposing algae and water weeds that have been washed ashore constitutes a major nuisance.[22] The growths also attract waterfowl, which contribute a heavy pollutional load.[26]

In the Arroya Seco of the Pasadena water supply, submerged rocks in the stream were colored a brilliant red by the growth of a dense mat of the filamentous bacterium *Crenothrix*. The water contained iron and H_2S from a bog drained by the stream, and the iron was being precipitated by the *Crenothrix*. Low pH, high CO_2 content, extreme hardness, and lack of dissolved oxygen made the water a perfect environment for the *Crenothrix*. Fragments from the growth together with sulfate released in the water were troublesome.[28]

At the Ivanhoe Reservoir of the Los Angeles water system, the eelgrass pondweed *Potamogeton pectinatus* grew abundantly. Many tons of the growth had to be removed when the stems sloughed off near the roots and were blown ashore.[29]

In the Salt River Valley, the use of irrigation canals was seriously hampered by extensive attached growths of algae, moss, and rabbits foot grass. Somewhat similar growths were reported in the canals and ditches in the Imperial Valley.[29] At Peter's Lake in the Los Angeles area, *Potamogeton* and *Chara* were the troublemakers, and in Toluc Lake, pond lilies became a nuisance.[29]

Aquatic Animals

Several types of aquatic animals also cause problems. Insect larvae may develop in large numbers. *Chironomus* red worms develop from eggs that are laid on water weeds and floating mats of algae. These larval forms change into pupae which later emerge as adult midge flies. *Chironomus* has been noted in numerous places in California and is always associated with uncovered reservoirs.

Black gnats develop from larvae that may be present in a water system that has a flowing stream as its source. The most objectionable feature of the gnat is its severe bite, which is reported to be often fatal to livestock.[30]

In San Diego County, open canals converted from an irrigation system to a public water supply were found to be

heavily infested with caddis flies that seriously restricted water flows during the summer months.[31]

Asiatic clams, *Corbicula fluminea*, have been troublesome in irrigation systems in the Coachella Valley in Southern California, and at the Tracy Pumping Station in central California, where they interfere with valves and sprinkler systems. More recently these clams have been found in the Colorado River near the aqueduct intake. Potentially, they are capable of reducing the carrying capacity of the aqueduct, of damaging the propellers of the centrifugal pumps, and of contributing tastes and odors to the water.[32]

Physicochemical Changes

Significant physicochemical changes may be brought about by heavy growths of planktonic algae in reservoirs. When light is present, their photosynthesis may cause that layer of water to become supersaturated with oxygen. When they die, their decay may reduce the amount of oxygen even in the top layers of water faster than it can be absorbed from the air.[33] One cause of rapid decrease in oxygen at lower depths during the summer is the decomposition of plankton blooms that have settled to the bottom.[34] A pH change in water is indicative of the production or consumption of CO_2. During photosynthesis, algae use the free CO_2 of the water, causing the pH to rise. As the free CO_2 is exhausted in waters of pH above 8.3, the bicarbonate present is used as a source of CO_2. If the $CaCO_3$ content is high, it may be precipitated, thereby causing a change in the total alkalinity. This change in alkalinity does not occur in the San Francisco reservoirs.[21] It has been reported for the Chadsworth Reservoir in the Los Angeles system, where a dense bloom of *Anabaena* was responsible. Hardness dropped from 120 to 90 ppm, and dissolved oxygen increased from 8.3 to 13.0 ppm, as *Anabaena* increased from 750 to 4,730 standard units per ml. *Cosmarium*, *Closterium*, and *Aphanizomenon* were also found capable of bringing about a softening of the water.[35] In water below the thermocline, this same phenomenon may produce an increase in hardness, as the dissolved CO_2 will redissolve the precipitated normal carbonates when they settle toward the bottom.[36]

Tastes and Odors

At Menlo Park, H_2S has been considered the worst offender, and algae next worst, in creating tastes and odors that develop quickly in the uncovered storage reservoir after a few days of hot, sunny weather. Hit-or-miss chlorination tends to intensify the tastes and odors produced by algae, and they are not reduced by aeration.[4]

In Morris Reservoir, the Pasadena water department closely limited the growth of plankton in order to prevent the imparting of tastes and odors to the water. When water was treated at the dam with ammonia and chlorine, the chlorinous tastes were prevented but tastes and odors already present were not eliminated. At the end of a transmission conduit 18 mi long, a prominent grassy or fishy odor was evident as the water reached the covered storage reservoir. The algae abundant during the summer were *Staurastrum*, *Pandorina*, *Eudorina*, and *Anabaena*.[37]

Kofoid stated that there were numerous odor-producing organisms in California.[38] Two outstanding ones were considered to be the source of much of the trouble in the reservoirs of San Francisco. One, *Ceratium*

hirundinella, is capable of rapid multiplication, causing discoloration of the reservoir water to a rusty brown and creating an almost unbearable stench. The intense odor from this organism can be a problem throughout most of the year. The blue-green algae were considered by Kofoid as second in importance in California as odor producers. *Anabaena* was one offender, but *Cylindrospermum* was the principal source of trouble from the blue-green group in San Francisco. Odors from blue-green algae occur especially during August and September.[38]

The East Bay Municipal Utility District, serving Oakland, Berkeley, Richmond, Alameda, and other nearby communities, found from experience that the four algae most apt to cause tastes and odors were *Aphanizomenon,* during any month of the year; *Anabaena,* from April to December; *Ceratium,* usually March to October; and *Volvox,* from March to December.[38]

The earthy, musty odors were present over a period of many years in the Los Angeles aqueduct water supply as well as in Lower Hollywood, Bouquet, and Haiwee reservoirs. The earthy, musty odors did not correlate with plankton or attached growths. The organic matter present was considered sufficient to support bacteria such as *Streptomyces.* It was assumed that these actinomycetes were responsible for the odors.[6] These bacteria required some available nitrogen in order to give rise to the musty, earthy, or woody odors.[39]

Tastes and odors caused by anaerobic decomposition of plankton in the hypolimnion have been present in lakes and reservoirs that stratify during the summer. When the stratification disappears and the water becomes uniform during the winter, the tastes and odors may be disseminated throughout the whole body of water. In Murry Lake in San Diego County, this occurs in mid-December.[40] Tastes and odors in the hypolimnion have required special attention in Lower Hollywood and Encino reservoirs operated by the City of Los Angeles. The decomposing organic debris included dead algae, aquatic weeds, leaves, and dead fish.[41]

In the Devil's Gate Reservoir at Pasadena, the decomposing organic matter, through seepage, reached the Monk Hill underground basin, causing organic tastes and odors to develop in the ground water which was being pumped from wells as part of Pasadena's water supply.[42]

At Culver City, tastes and odors and other ill effects resulted from a heavy infestation of iron and sulfur bacteria in the underground water supply. The organisms included *Crenothrix* and *Beggiatoa.*[43] Wilmington also used water containing iron, humates, and tannates that stimulated the growth of bacteria, causing the water to have tastes and odors.[44] Fresno City obtained water from wells tapping underground basins estimated to hold 600 cu mi of water. Although this water had a high iron content, bacteria were not present and it was free from odor.[45]

Treatment Plant Problems

Several water treatment plants report shortened sand filter runs due to algae. Sacramento found that overloading due to heavy algal growth and the attendant mudball formation in filters caused considerable difficulty. Chlorination ahead of coagulation resulted in longer filter runs, possibly by killing the small, motile, gelatinous organisms such as *Monas,* which otherwise would not settle out.[46]

Occasionally water from Lake Mathews, at the terminus of the Colorado

River aqueduct, causes difficulty in filter operation because of plankton. Coagulation is then used. This procedure is also used if growths develop suddenly before spot treatment can be applied.[47]

The East Bay Municipal Utility District found that filter runs varied within the plankton load. Ordinarily the runs are from 50 to 110 hr, but a heavy growth of diatoms decreased the runs to 5 hr.[48] The filters are considered to be more efficient during the summer when the plankton are abundant than in the winter.[33]

Algae sometimes develop as a thin film on the bottoms of Los Angeles River sedimentation basins. This film prevents the water from seeping downward to a deep infiltration gallery. By alternating the cleaning of the various basins, continuous operation can be obtained.[49]

Bacterial growths in filters and in softening plants have been encountered. Up to 10,000,000 cells per ml of exchange resin have developed in cation exchangers operated without germicides in Southern California.[50] These bacteria might produce tastes and odors and cause the resin particles to cement together.[51] Many surface waters and some ground waters contain sufficient organic matter to support abundant growths in the filters. Bacterial and fungus growths are listed as the principal causes of caking and short circuiting through the sand.[36]

Oscillatoria was responsible for the corrosion of steel tanks used for mixing, sedimentation, and filtration at a water softening plant located in the lower Tijuana Valley near the Mexican border. When the tanks were covered to shut out the light, the *Oscillatoria* stopped growing immediately.[52]

At Beverly Hills, filtration was used to eliminate bad tastes and odors that developed from the decomposition of *Crenothrix* and *Beggiatoa*.[53] These organisms are generally more troublesome when ground water is used as a source of supply.[54] Sacramento reported that rapid sand filtration was conducive to elimination of residual tastes resulting from organic matter in the river supply.[55] Continuous sludge removal, aeration, activated carbon, ammonia-chlorine, prechlorination, and superchlorination were provided [56] to help free the water of algal odors and the last vestige of the periodic summer taste.[55]

Infestations in Distribution Systems

The iron bacteria have been a persistent and widespread problem in many California water supplies. Wilson stated in 1945 that *Crenothrix* infestations have sometimes been spoken of in Southern California as the "water calamity" and that at least two cities in California can ruefully testify to the aptness of the term, for it has been their "Enemy No. 1" for years. The most important and critical factor in its development is carbonic acid. The organism flourishes only in waters where lower oxide carbonates of iron or manganese are present, and these are present only in water containing the free CO_2, according to Wilson.[57]

Crenothrix and *Gallionella* are the most troublesome growths of all to control. They invade the transmission and distribution systems where they thrive so well that they materially reduce the carrying capacity of the pipes. Three cities in the Los Angeles plain, Glendale, Hawthorne, and Manhattan Beach, suffered major difficulties with *Crenothrix*, necessitating drastic control measures.[54]

San Francisco had serious troubles with iron bacteria in the Hetch Hetchy tunnels, where the carrying capacity

of the conduit was reduced as much as 20 per cent. Inspection disclosed a slimy, gelatinous, light brown growth covering the entire inner surface of the pipe and up to 0.25 in. thick. The source of the trouble was discovered to be seepage into the Coast Range tunnels of water containing almost pure cultures of the organism. Water, if left standing in the conduit, developed a strong objectionable medicinal or woody taste.[57]

At Pasadena, a water supply system of almost a mile of tunnels, which once supplied the city with more than 50 per cent of its total consumption, was abandoned due to tastes, odors, and color produced by heavy growths of *Crenothrix* and *Beggiatoa*.[42] In Glendale, some of the wells were infested with *Crenothrix* which soon spread to the distribution system. Water drawn from the faucets always contained red-brown flecks of *Crenothrix* up to 1 in. long. Some of the smaller pipes were soon plugged with adherent growth. A large amount of growth also developed on the thousands of gate bonnets throughout the system.[59] Palo Alto received over 1,200 complaints per year from the consumers because of red water and foul odors resulting from *Crenothrix* infestation of the distribution system, and was forced to take drastic control measures.[60]

Several other organisms have been reported in distribution systems throughout the state. *Beggiatoa* was present in several suburban areas of Los Angeles, but only in untreated waters. Sulfide-producing bacteria, probably of several kinds, have occurred often in water pipe. In one case at Beverly Hills, new white-lead paint in a bathroom was blackened as a result of the sulfide in the bath water. At the treatment plant, the water had been freed of sulfides but the sulfur bacteria in the distribution system produced it again.[57] Santa Rosa water lines developed a slimy, brown to black growth of nonfilamentous bacteria which gave rise to an odor that varied from musty to distinctly septic and was prominent especially in dead ends and other sections with restricted circulation.[61]

At Stockton, well water stored in an uncovered reservoir turned almost black due to small amorphous particles that contained large numbers of a bacillus form of iron bacteria. Diatoms and some green algae were also present in the water.[62]

Los Angeles River water that had percolated through peat was brought to the surface as well water free of turbidity. When held for 48 hr, it became turbid, and black filamentous masses of bacterial growth separated out. This not only gave an unsightly appearance to the water but was accompanied by an offensive odor.[63]

Additional organisms that have been encountered in distribution systems in the state are *Gallionella*,[64] *Leptothrix* (in the Hetch Hetchy supply),[65] nematodes,[66] and the insect *Limnophora*.

Standards for High-Quality Water

The California water permit law makes it unlawful to supply impure, unwholesome, unpotable, polluted, or dangerous water for human consumption or for domestic purposes.[67] The State Public Utilities Commission issued a ruling that "the presence of algae, *Crenothrix*, and other growths in the water shall be controlled by proper treatment."[68]

A manual of procedures for handling water quality complaint investigations, prepared originally for the East Bay Utility District, has been disseminated by the California Section of AWWA.

It includes sections on tastes and odors as well as on worms and bugs in water.[69]

The California Section adopted standards in regard to reservoirs, emphasizing that reservoirs should have provision for protection against marginal vegetation and algal growths, and that means for withdrawal of water from various levels should be provided.[70] Another standard proposed was that mains with dead ends should be flushed as often as necessary to maintain the proper quality of the water.[68]

Detection of Plankton

Collection of samples for detection of plankton has involved the use of the plankton net. The net was pulled upward through the water, and the volume of algae caught by the net was recorded in parts per million [71] or as cubic centimeters per cubic meter of water.[67] Modern laboratories now are equipped to make microscopic analyses of water samples collected from various depths in the reservoir. The organisms have been recorded in areal standard units,[37] and as the number of organisms per cubic meter.[72] Records kept regularly over a period of years make it possible to detect any departure from the norm which would indicate that a modification in the water treatment was warranted.[28] Frequency of sampling varies considerably. For Lake Mathews, at the terminus of the Colorado River aqueduct, samples are collected from seven areas twice weekly.[47]

Algicides for Reservoirs

Copper sulfate has been used for many years and in large quantities for the control of algae in reservoirs. San Francisco has used it since 1912, the treatment at that time consisting of dragging bags of copper sulfate back and forth behind a boat.[73] The procedure was later modified, the algicide being dissolved in a small amount of water and sprayed from nozzles under a pressure of 30–50 lb and covering a zone up to 50 ft in width.[74] With this method, 250 acres per day can be covered, applying as much as 8,000 lb of copper sulfate.[72] Approximately 80,000 lb is now used annually for control of algae in San Francisco's local storage and impounding reservoirs.[75] The copper appears to settle out slowly, remaining effective as an algicide for as long as 48 days.[76]

Los Angeles has more than 25 open reservoirs ranging from about 10 to 180,000 acre-ft. They are subject to widely diverse climatic and topographic conditions, with elevations from about 375 ft to over 7,000 ft. Therefore, there is a great variety of biological activity that often produces water of unsatisfactory quality. As the only treatment before the water enters the distribution system is simple chlorination, the quality of the raw water supplies has to be rigidly controlled. The principal problems encountered are pond weed growths, plankton activity, and tastes and odors.[22] In 1945, over 50 per cent of the surface treatments were for blue-green algae, and another 30 per cent were for diatoms.[77] More recently, surface treatments have been predominantly for diatoms during the winter season.

In 1936, a new method of applying copper sulfate to the Los Angeles reservoirs was reported. A scattering machine on a fast boat spread the copper sulfate crystals uniformly over the water. The crystals dissolved as they fell through the water, thus giving a uniform vertical distribution; the

larger the crystals, the greater the depth affected. Up to 140 acres could be treated in 1 hr, and there were savings both in labor and the amount of copper sulfate required.[23] The scattering machine was later replaced by the belt conveyor equipment.[78] Pond weed and duckgrass have been controlled with a solution-feed device located at the reservoir inlet, which maintains a constant copper residual in the reservoir.[78]

In 1938, Goudey stated that one of the most perplexing problems in treating reservoirs was the determination of the proper time when treatment should be administered.[79] Residual copper treatment rather than intermittent treatment when particular organisms reached predetermined limits has helped to reduce this difficulty. In the past, Los Angeles consumed up to 165 tons of copper sulfate per year. The present consumption is estimated to be approximately 700 tons per year. The combined benefits have more than justified the increased cost.[6]

Most treatments are for algae present near the surface, but occasionally concentrations of organisms at depths of 20, 50, or even 100 ft must be considered. At Morris Reservoir, at 105 ft depth, 160 areal standard units of *Asterionella* and 150 of *Melosira* were recorded. Treatment with copper sulfate must then be increased to be effective at this depth.[37]

Chlorine has been used to control algae, especially when the particular forms were resistant to copper sulfate. An alga reported as *"Protococcus"* was destroyed in a Los Angeles reservoir with a chlorine dosage of up to 1 ppm.[80] More recently, chlorination of the hypolimnion has been carried out to improve water quality, including the reduction of tastes and odors.[41]

Both chlorine and copper sulfate have been applied to open canals used either for irrigation or as a part of a public water supply system.[31] Continuous treatment with low concentrations is more effective than occasional applications of high concentrations.

Activated Carbon

In attempts to control tastes and odors, activated carbon has been used. At Los Angeles, 40 tons of activated carbon was used in one month to reduce an earthy, musty odor.[6] Culver City has used filters of activated granular carbon to eliminate tastes and odors resulting from a heavy infestation of iron and sulfur bacteria in the underground water supply.[43]

Alum was distributed in a 40-mil gal reservoir at Los Angeles. Both the alum and the activated carbon can be applied in the dry form by means of a special blower device.[81]

Selective Draft

Sufficient gates at various elevations are necessary to select water of the best quality and to avoid problems associated with summer stratification in reservoirs.[9] One gate should be located within a foot of the bottom to remove the potential hypolimnion before oxygen depletion can take place.[41] In the upper layers, the clearest water may be at one depth in the morning and at another in the evening.[20] Selection of the best water thus requires frequent sampling and enumeration of organisms found at the various depths.[36]

Reservoir and Canal Covers

Although the initial cost is high, covering canals and smaller storage reservoirs has been found to be effective both in preventing the growth of algae

and in preventing infestations of caddis flies,[31] *Chironomus*,[30] and insects. At Glendale, the roof was removed from the service reservoir. The abundant growth of algae that followed, however, forced officials to construct a new roof because of the public complaints about the green water. Pasadena and Los Angeles have had similar expereiences.[52]

Certain past infestations have been eliminated by covering all openings in partially covered reservoirs and basins with a small mesh screen. At Stockton, the midge fly was controlled in this way.[53] Some San Francisco reservoirs have been protected from sea gulls by stringing wires 30 ft apart above the water surface.[54]

On the Mokelumne River project, a deep and narrow reservoir was planned. By thus reducing the amount of surface water exposed to sunlight, the reservoir would afford little opportunity for the growth of plankton algae and water weeds.[55]

Control of Weeds

Both chemical and mechanical measures have been taken in desperate attempts to control the attached growths in reservoirs. Los Angeles and San Francisco have used a number of chemicals, and although several of them are effective, the effectiveness of each is limited to a certain set of conditions.

Copper sulfate at 2 lb/mil gal controlled many weeds, but only if the water was replaced within 24 hr. *Potamogeton* was killed in Dry Canyon Reservoir with a heavy dosage of copper sulfate, but at San Francisco the same treatment did not kill *Chara*, although the gelatinous algae attached to the *Chara* were removed by the copper. At Silver Lake Reservoir in the Los Angeles system, copper sulfate sprinkled dry over the reservoir bottom before refilling reduced this weed growth for a short period, but a constant residual was required for effective control.

Various herbicides such as chlorinated hydrocarbons, 2,4-D ammonium sulfamate, and arsenicals were all effective on certain weeds or under certain conditions, but their high cost, their tendency to produce tastes, their toxicity to animals, or other drawbacks have prevented them from being considered as ideal for use in large water supply reservoirs.[29]

Mechanical procedures such as cutting and pulling or raking the weeds, rapidly lowering or raising the water level, burning over exposed shores, and clearing the reservoir site of all growth before filling have often been the most effective and desirable control procedures.[24]

Watershed Control

Prohibition of the use of the land surrounding each reservoir for agriculture, recreation, or housing is the simplest method for preventing both pollution and enrichment with algal nutrients.[56] This becomes impossible as additional reservoirs are required for public water supplies and as competition for impounded waters for various uses becomes greater.

Arnold considered that such conditions already exist in the Southwest, and that the use of the water supply lakes for public recreation is justified.[57] Dodson emphasized that the control of watersheds must slowly conform to the more general needs of the area, its people, and its total economy.[58] The city of San Diego has for a long time permitted hunting, fishing, and boating on water department reservoirs under strict supervision.[57]

In the East Bay District, strict sanitary control of the watersheds, on which 10,000 people live, is maintained. Recreational use of the reservoirs has been considered a "plague," as it requires constant inspection.[86]

Thirty years ago, Jenks stated that it may be less expensive and more reliable to filter the water than to provide an increasingly elaborate watershed protection.[89] Wilson, however, said that control of plankton growths in impoundments lightens the task of treatment at the plant. He warned that it was erroneous to assume that filtration and other processes of "modern complete treatment" would make it unnecessary to control plankton growths in impoundments.[86]

Control by Filtration

A number of communities use not only well water but surface water without filtration, and coagulation is not as common a practice in California as it is in many other parts of the United States. Where filters are used in the Southwest, the problems involve the removal of algae, with the minimum use of backwash water [54] and with the prevention of abundant growths in the filters of bacteria and fungi that cause caking and short circuiting through the sand.[36] At Wilmington, these growths were controlled by heavy chlorination of the sand beds every 8–10 days.[44]

Microstraining processes for removing plankton from water have been in operation on a pilot scale [90] in Azusa and Lake Cachuma. A permanent installation of a microstrainer is in operation at Fontana.

Control of Organisms in Distribution Systems

Many methods have been tested for control of persistent growths of iron, sulfur, and slime-forming bacteria in distribution systems and closed aqueducts. Significant control measures are aeration,[91] use of copper sulfate, flushing of dead ends or even of a whole system,[60] and the addition of lime [92] and of sodium hexametaphosphate.[61]

At Riverside, for concrete pipes of an irrigation system, the periodic use of mechanical scrapers was found to be cheaper than chemicals for the removal of the pupal cases of *Limnophora.*[93] Pipes were effectively cleared by the use of inflated rubber balls covered with a network of chains and carried through by the force of the water. Growths of fresh-water sponges have also been removed by mechanical means.[93]

For many systems, chlorination is an essential part of treatment for the infestations. At Los Angeles, it was assumed that the great oxidation potential of chlorine was important in addition to its toxic quality. For this reason, the practices of superchlorination and break-point control were used for the control of slime growths and their odors and tastes in the distribution system.[94]

At Torrance, a chlorine dosage of 5 ppm was used, producing a residual of 0.3 ppm. This permitted dissolved oxygen to extend throughout the system, and it was concluded that, as long as oxygen was present, biologic activity would continue in the pipes but would serve only to purify the water.[95]

At Glendale, after experimenting with sodium carbonate treatment to starve out the *Crenothrix,* chlorination was finally used, since the former method reduced but did not eliminate the complaints of "algae" in the water.[59]

The practice of continuous chlorination of the system to maintain a free

chlorine residual of 0.4 ppm has been practiced at Palo Alto,[60] although others have found ammonia-chlorine treatment more effective in completely eliminating growths throughout the system.[58]

Toxic Algae

Blooms of certain blue-green algae frequently are toxic to waterfowl and animals that drink water where the blooms are present. In the lower Klamath and Tule Lake areas of California, huge algal masses including *Anabaena* have developed in the late spring. Grebes have been dying each year just at the time that the algal bloom reaches its peak. Rosen assumed that the fish on which the grebes fed possibly contained the algal toxin. Rosen has suggested also that the botulism organism may live on the products of algal decomposition at the bottoms of lakes and reservoirs.[96]

In 1933 Decker reported on investigations of gastrointestinal outbreaks ascribed to the water supplies in Eagle Rock and Pacific Palisades and concluded that the outbreaks might be traced to decaying vegetable matter.[97] Although this material could have been primarily algal in origin, there was no evidence presented to indicate that an algal toxin was involved.

Conclusion

Statements made by Wilson in 1932 concerning the biology of water supplies in California are still applicable today, as indicated by the following sentences:[36]

> Biological control is undoubtedly as important a factor in treatment plant operation as is the use of a coagulant, and the more carefully the biology of the various units in the plant and the impounding system is studied, the better and the more uniform will be the quality of water in service. . . . The ability to draw water from any desired stratum should be considered an indispensable element of biological control, and sufficient study of water at all levels should be made to enable intelligent selection of the point from which water for treatment is to be drawn.

Again, in 1937, in a paper forecasting the next years in California water treatment practices, Wilson referred to the movement to have all surface water supplies of importance filtered and treated for taste and odor control. He predicted a rapid spread in the use of activated carbon and an increasing use of copper sulfate and chlorine for control of algae, with improved methods for application. He expected that weeds and marginal growths would be more generally controlled to improve that water quality.[98]

Earlier he had described how certain growths, such as *Scenedesmus,* could be very beneficial in helping to restore balanced biological conditions in the reservoir. The algal growth actually improved the quality of the water.[99]

Stead and Reinke stated that the job included making regular inspections of watersheds by qualified men, routine studies and control of algae and other aquatic growths in open reservoirs, and the routine inspection and flushing and treatment of distribution lines.[100]

Even for the present day, the above statements summarize the important place that aquatic organisms have in the water supplies of the Southwest.

References

1. Morris, S. B. Water Works Management and Los Angeles Progress. *Jour. AWWA,* 42:654 (Jul. 1950).
2. Bailey, P. Water Resources of California. *Jour. AWWA,* 14:309 (Oct. 1925).

3. Morris, S. B. The Colorado River—The Southwest's Greatest Natural Resource. *Jour. AWWA,* 39:945 (Oct. 1947).
4. Cook, L. H. Water Quality Problems in Small Systems. *Jour. AWWA,* 34:911 (Jun. 1942).
5. Blakeley, L. E. The Rehabilitation, Cleaning, and Sterilization of Water Wells. *Jour. AWWA,* 37:101 (Jan. 1945).
6. Bartholomew, K. A. Control of Earthy, Musty Odors in Water by Treatment With Residual Copper. *Jour. AWWA,* 50:481 (Apr. 1958).
7. Hyatt, E., Jr. Control of Appropriations of Water in California. *Jour. AWWA,* 13:125 (Feb. 1925).
8. Hyatt, E., Jr. The Central Valley Project of California. *Jour. AWWA,* 30:389 (Mar. 1938).
9. Eckart, N. A. Benefits Accruing from the Hetch Hetchy Project, San Francisco Water Supply. *Jour. AWWA,* 28:1211 (Sep. 1936).
10. Berry, W. L. The California Water Plan. *Jour. AWWA,* 42:381 (Apr. 1950).
11. Shelton, M. J. Progress of the California Water Plan. *Jour. AWWA,* 51:1349 (Nov. 1959).
12. Langbein, W. B. Municipal Water Use in the United States. *Jour. AWWA,* 41:997 (Nov. 1949).
13. Ongerth, H. S. Sanitary Construction and Protection of Wells. *Jour. AWWA,* 34:671 (May 1942).
14. Hyatt, E., Jr. Water Development Plans for California. *Jour. AWWA,* 39:430 (May 1947).
15. Patric, J. H. Increasing Water Yield in Southern California Mountains. *Jour. AWWA,* 51:474 (Apr. 1959).
16. Hoppaugh, K. W. A Taxonomic Study of the Genus *Vaucheria* Collected in California. *Am. J. Botany,* 17:329 (1930).
17. Drouet, F. *Myxophyceae* of Eastern California and Western Nevada. *Bot. Ser. Field Museum Nat. Hist.,* 20:145 (1943).
18. Allen, W. E. A Quantitative and Statistical Study of the Plankton of the San Joaquin River and its Tributaries In and Near Stockton, California, in 1913. *Univ. Calif. Publ. Zool.,* 22:1 (1920).
19. Purer, E. A. Ecological Study of Vernal Pools, San Diego County. *Ecology,* 20:217 (1939).
20. Johnson, M. W. Relation of Plankton to Hydrographic Conditions in Sweetwater Lake. *Jour. AWWA,* 41:347 (Apr. 1949).
21. Medbery, H. C. Limnological Observations on San Francisco Reservoirs. *Jour. AWWA,* 34:719 (May 1942).
22. Derby, R. L. Methods of Controlling Aquatic Growths in Reservoirs. *Jour. AWWA,* 46:1150 (Nov. 1954).
23. Goudey, R. F. A New Method of Copper Sulphating Reservoirs. *Jour. AWWA,* 28:163 (Feb. 1936).
24. Arnold, G. E. Weed Growths in Reservoirs and Open Canals. *Jour. AWWA,* 27:1684 (Dec. 1935).
25. Orcutt, C. R. Aquatic Plants in the Vicinity of San Diego. *West. Am. Sci.,* 3:123 (1887).
26. Derby, R. L. & Graham, D. W. Control of Aquatic Growths in Reservoirs by Copper Sulfate and Secondary Effects of Such Treatment. *Proc. Am. Soc. Civil Engrs.,* 79:203:1 (1953).
27. Goudey, R. F. Algicides. *Wtr. Wks. Eng.,* 99:393 (1946).
28. Lynde, E. J. & Marks, F. E. Sleuthing in a Water Works Chemical Laboratory. *Jour. AWWA,* 37:1144 (Nov. 1945).
29. Goudey, R. F. Chemical Weed Control. *Jour. AWWA,* 38:186 (Feb. 1946).
30. Arnold, G. E. Plankton and Insect Larvae Control in California Waters. *Jour. AWWA,* 28:1469 (Oct. 1936).
31. Burzell, L. R. Growth and Conversion of Water Systems in San Diego County, California. *Jour. AWWA,* 49:531 (May 1957).
32. Ingram, W. M. Asiatic Clams as Potential Pests in California Water Supplies. *Jour. AWWA,* 51:363 (Mar. 1959).
33. Burnson, B. Seasonal Temperature Variations in Relation to Water Treatment. *Jour. AWWA,* 30:793 (May 1938).
34. Ramsey, W. L. Dissolved Oxygen in Sweetwater Lake. *Limnology and Oceanography,* 5:34 (1960).
35. Graham, D. W. Investigation of an Unusual Natural Water Softening. *Jour. AWWA,* 34:589 (Apr. 1942).

36. Wilson, C. Biological Control as Affecting Plant Operation. *Jour. AWWA,* 24:1792 (Nov. 1932).
37. Sopp, C. W. Plankton Control in Morris Reservoir. *Jour. AWWA,* 28:447 (Apr. 1936).
38. Kofoid, C. A. Microscopic Organisms in Reservoirs in Relation to the Aesthetic Qualities of Potable Waters. *Jour. AWWA,* 10:183 (Mar. 1923).
39. Silvey, J. K. G. Discussion—Control of Earthy, Musty Odors in Water by Treatment with Residual Copper, by K. A. Bartholomew. *Jour. AWWA,* 50:486 (Apr. 1958).
40. McEwen, G. F. Observations on Temperature, Hydrogen-Ion Concentration, and Periods of Stagnation and Overturning in Lakes and Reservoirs of San Diego County, California. *Bull. Scripps Inst. Oceanog. Univ. Calif.,* 4:219 (1941).
41. Derby, R. L. Chlorination of Deep Reservoirs for Taste and Odor Control. *Jour. AWWA,* 48:775 (Jul. 1956).
42. Lynde, E. J. & Ackerman, T. V. Effect of Storage Reservoir Detritus on Ground Water. *Jour. AWWA,* 36:315 (Mar. 1944).
43. Harnish, C. P. Granular Activated Carbon Filter Plant at Culver City, California. *Jour. AWWA,* 29:66 (Jan. 1937).
44. Hurlbut, W. W. Modifying an Unusual Filter Plant to Operate Successfully. *Jour. AWWA,* 28:1868 (Dec. 1936).
45. Barnum, E. K. Fresno City Water Corporation. *Jour. AWWA,* 13:81 (Jan. 1925).
46. Stevenson, R. A. Prechlorination in Relation to Filter Plant Efficiency. *Jour. AWWA,* 23:446 (Mar. 1931).
47. Streicher, L. Monitoring of Stream Water Quality—Colorado River Aqueduct System. *Jour. AWWA,* 50:1222 (Sep. 1958).
48. De Costa, J. D. Orinda Filtration Plant of the East Bay Municipal Utility District, Oakland, California. *Jour. AWWA,* 28:1551 (Oct. 1936).
49. Imbertson, N. M. Reclaiming the Los Angeles River. *Wtr. Wks. Eng.,* 112:1089 (1959).
50. Wilson, C. Control of Bacterial Reproduction in Cation-Exchange Layers. *Jour. AWWA,* 41:942 (Oct. 1949).
51. Streicher, L. & Bowers, A. E. Cation Exchangers for Municipal Water Softening. *Jour. AWWA,* 42:81 (Jan. 1950).
52. Myers, H. C. The Role of Algae in Corrosion. *Jour. AWWA,* 39:322 (Apr. 1947).
53. Perhab, J. L. & Taylor, A. Water Softening at Beverly Hills. *Jour. AWWA,* 25:504 (Apr. 1933).
54. Wilson, C. Control of Growths in California Distribution Systems—Introduction. *Jour. AWWA,* 42:849 (Sep. 1950).
55. Jenks, H. N. Dividends from Water Purification at Sacramento. *Western City,* 7:10:19 (1931).
56. Jenks, H. N. Sacramento Sets New Standards in Pre-Treatment. *Eng. News-Record,* 111:1 (1933).
57. Wilson, C. Bacteriology of Water Pipes. *Jour. AWWA,* 37:52 (Jan. 1945).
58. Arnold, G. E. *Crenothrix* Chokes Conduits. *Eng. News-Record,* 116:774 (1936).
59. Wilson, C. Control of Growths in California Distribution Systems—Glendale Experience. *Jour. AWWA,* 42:855 (Sep. 1950).
60. Blair, G. Y. Combating Pipeline Growths by Maintaining Chlorine Residuals Throughout a Distribution System. *Jour. AWWA,* 46:681 (Jul. 1954).
61. Brown, K. W. Control of Growths in California Distribution Systems—Santa Rosa Experience. *Jour. AWWA,* 42:851 (Sep. 1950).
62. Brown, K. W. Experiences with Well Water in an Uncovered Reservoir. *Jour. AWWA, 25*:337 (Mar. 1933).
63. Wilson, C. Unusual Color Removal Plant. *Jour. AWWA,* 23:689 (May 1931).
64. Wolfe, R. S. Cultivation, Morphology, and Classification of the Iron Bacteria. *Jour. AWWA,* 50:1241 (Sep. 1958).
65. Barbee, E. W. Tuberculation Measurement as an Index of Corrosion and Corrosion Control. *Jour. AWWA,* 39:220 (Mar. 1947).
66. Chang, S. L.; Woodward, R. L.; & Kabler, P. W. Survey of Free-Living Nematodes and Amebas in

Municipal Supplies. *Jour. AWWA,* 52:613 (May 1960).

67. ONGERTH, H. J. California Water Permit Law. *Jour. AWWA,* 44:149 (Feb. 1952).
68. WELMON, W. C. Service Rules and Standards for California Water Utilities. *Jour. AWWA,* 50:129 (Jan. 1958).
69. BURNSON, B. I. *Manual of Procedures for Handling Water Quality Complaint Investigations.* East Bay Municipal Utility District, Oakland, Calif. (1954).
70. ALEXANDER, L. J. California Water Supply Standards. *Jour. AWWA,* 41:1 (Jan. 1949).
71. LANGELIER, W. F. Water Treatment and Laboratory Control. *Jour. AWWA,* 13:476 (Apr. 1925).
72. MEDBERY, H. C. Algae Control in Reservoirs of San Francisco Systems. *Wtr. Wks. Eng.,* 99:14 (1946).
73. LENDALL, H. N. A Comprehensive Survey of the Taste and Odor Problem. *Taste Odor Control J.,* 12:10:1 (1946).
74. COX, C. R. A Review of Recent Progress in the Elimination of Tastes and Odors from Water Supplies. *Jour. AWWA,* 28:1855 (Dec. 1936).
75. TURNER, J. H. San Francisco's Water Supply. *Jour. AWWA,* 51:1061 (Sep. 1959).
76. MEDBERY, H. C. Copper Sulfate Dispersion and Settlement. *Jour. AWWA,* 34:735 (May 1942).
77. GOUDEY, R. F. Algicides. *Wtr. Wks. Eng.,* 99:479 (1946).
78. DERBY, R. L. & TOWNSEND, F. W. Reservoir Treatment by Improved Methods. *Wtr. & Sew. Wks.,* 100:211 (1953).
79. GOUDEY, R. F. Sunshine and Algae Control. *Eng. News-Record,* 120:581 (1938).
80. WILSON, C. Chlorine Control of Certain Algae Growths in Los Angeles Reservoirs. *Western City,* 7:10:25 (1931).
81. Dusting Reservoirs with Chemicals. *Eng. News-Record,* 121:300 (1938).
82. DIEDERICH, P. Necessity for Roofs on Service Reservoirs. *Western City,* 7:11:30 (1931).
83. FLENTJE, M. E. Control and Elimination of Pest Infestations in Public Water Supplies. *Jour. AWWA,* 37:1194 (Nov. 1945).
84. Protecting Reservoirs from Bird Nuisance. *Eng. News-Record,* 120:110 (1938).
85. DAVIS, A. P. Additional Water Supply Project for East Bay Municipal Utility District in California. *Jour. AWWA,* 13:424 (Apr. 1925).
86. LAVERTY, G. L. Views on Watershed Control, East Bay District. *Jour. AWWA,* 46:414 (May 1954).
87. ARNOLD, G. E. Public Use of Reservoir Lands and Waters. *Jour. AWWA,* 40:947 (Sep. 1948).
88. DODSON, R. E., JR. Views on Watershed Control—San Diego. *Jour. AWWA,* 46:409 (May 1954).
89. JENKS, H. N. Developments in Western Water Supply Practice. *Eng. News-Record,* 106:438 (1931).
90. BOUCHER, P. L. Micro-Straining. *J. Brit. Wtr. Wks. Assoc.,* 41:477 (1959).
91. STUART, F. E. Seen and Heard in the Field, Kinds, Gadgets, Ideas. *Jour. AWWA,* 28:1621 (Oct. 1936).
92. ELDER, C. C. Water Supply for Construction Camps. *Jour. AWWA,* 27:613 (May 1935).
93. DERBY, R. L. Control of Slime Growths in Transmission Lines. *Jour. AWWA,* 39:1107 (Nov. 1947).
94. ALEXANDER, L. J. Control of Iron and Sulfur Organisms by Super-Chlorination and De-Chlorination. Experiences and Conclusions Since 1940. *Jour. AWWA,* 36:1349 (Dec. 1944).
95. POMEROY, R. & MONTGOMERY, J. M. Control of Growths in California Distribution Systems—Torrance Experience. *Jour. AWWA,* 42:858 (Sep. 1950).
96. Waterfowl Deaths From Algae. *Outdoor California,* 21:14 (1960).
97. DECKER, C. W. Discussion—Obscure Gastrointestinal Outbreaks Ascribed to Water Supply, by C. Wilson. *Jour. AWWA,* 25:1064 (Aug. 1933).
98. WILSON, C. Forecasting the Next Decade in California Water Treatment Practice. *Western Construct. News,* 12:379 (1937).
99. WILSON, C. The Biological Control of Impounding Reservoirs. *Jour. AWWA,* 17:247 (Feb. 1927).
100. STEAD, F. M. & REINKE, E. A. Water Quality Control in California. *Jour. AWWA,* 41:131 (Feb. 1949).

Customer Service Lines

AWWA Distribution Manual

A training course in water distribution has been prepared under the supervision of AWWA Committee 4620 M—Education. The document is being published in installments (April 1961 issue, p. 458; June 1961 issue, p. 790; July 1961 issue, p. 907; August 1961 issue, p. 1174), and will afterwards be made available as a separate volume.

THE pipe leading from the distribution main to the plumbing system of individual premises is commonly called a service line. Each service line consists of two main parts: (1) the service connection, which extends from the main in the street to the curb or property line and is usually, though not always, installed by the utility; and (2) the portion which extends from the curb or property line to the building and is usually installed at the customer's expense.

Connection Charges

The utility normally installs the service connection, because the installation involves attachment to its main, working in public streets, and highways, crossing other utility lines, and may require street-opening permits, fees, and a bond to guarantee approved roadway placement. It is logical that such responsibility be borne by one qualified party rather than by many individuals. The cost of installing the portion of the service from the main to the curb or property line may or may not be charged to the customer, depending on local practice or regulatory requirements.

The portion of the customer's service from the curb or property line to the building is usually installed by a plumber at the customer's expense, although the utility may, and usually does, control such work by prescribing standards for materials, minimum pipe sizes and depths, and other details in order to insure proper installation.

Usually each customer is served by an individual service line. In multifamily units, however, such as apartment buildings and various types of business or commercial properties, one service may be used to serve all occupants, in which case only the owner contracts with the utility for water service.

The owner may allocate the cost of water service among the tenants by submetering or some other form of prorating, or he may make no attempt to bill his tenants, including the cost of water service in his rental charges

instead. If the service is not metered, the utility may base its charges on the number of plumbing fixtures. In either case, however, the utility should contract with one responsible party and not become involved in prorating individuals.

Sometimes several individual lines are run to the separate premises from a single service connection installed by the utility to the curb or property line. Then, of course, it is possible to install separate meters.

Service Connection Components

Each service connection consists essentially of a connection to the distribution main, a length of service pipe leading to a curb cock or turnoff valve located outside the curb line or near the property line, and another length of service pipe to the plumbing system of the premises. The service pipe is generally connected to the distribution main by means of a corporation stop inserted in the main. The insertion is normally accomplished while the main is in service and under pressure, and is thus known as a "wet" connection. Occasionally outlets are provided in the main when it is originally installed, particularly if the service connections are large. The corporation stop can be turned to shut off the flow in the service line, as is often done to reduce the possibility of leakage when the service connection is discontinued. Ordinarily, water service to the premises is turned on or off at the curb stop located near the curb and accessible through a curb box placed over it.

A meter may be inserted in the service line either at or near the curb stop or inside the premises served. If an outside meter setting is used, the curb stop may be incorporated in it.

Installation and Material Specifications

Every water utility should have definite regulations and specifications for service and meter installations and should set forth responsibility for payment of costs. The specifications may be in the form of sketches which detail how the service line is to be installed, sizes and kinds of approved service line materials, and any other information necessary to provide a complete understanding of installation requirements. Lack of such knowledge on the part of the customer often can result in misunderstandings and strained relations.

Selection of Service Line Materials

The cost of installing customer service connections—that portion of the service from the main to the curb or property line—commonly exceeds 10 per cent of the total investment of a water utility. It is important, therefore, that every effort be made to select service line materials that will give the longest possible satisfactory service.

The most important factor affecting the useful life of service lines is the ability of the materials used to resist internal and external corrosion. Internal corrosion may be of two general forms: pitting, which results in failure of the pipe or fitting material to withstand presure and causes blow-outs or leakage; and tuberculation, which reduces the carrying capacity of the pipe. These actions may progress so far that the service line must be replaced. Obviously, materials selected for service lines must have sufficient strength to withstand the maximum pressures to which they may be subjected.

The type of materials used for service installations should be chosen only after consideration has been given to all pertinent factors. True cost involves life expectancy as well as the original cost. Leaking service lines are one of the most expensive maintenance problems in water utility operation, and replacement costs are high. In addition, faulty services are a primary source of unaccounted-for water.

TABLE 6.1

Demand Rates of Household Plumbing Fixtures and Appliances

Fixture or Appliance	Demand gpm
Bathtub	4
Dishwasher	3–5
Disposal unit	2–3
Kitchen sink	4
Laundry tub	5
Lawn sprinkler	5
Shower	3
Tank toilet	4
Washbasin	3
Washing machine	3–7

Service Line Materials

Materials most commonly used for service lines include copper, brass, lead, cast iron, black and galvanized wrought-iron and steel, asbestos-cement, and plastics of various types.

Lead and Brass Pipe

Lead was one of the earliest materials to be commonly used for service piping. It was flexible, with relatively long life and sustained carrying capacity. Because of the high cost both of the material itself and the labor in jointing, it is not commonly used today.

Brass is another material that was once used, although not so extensively. Both red- and yellow-brass pipe have fairly long lives and sus-

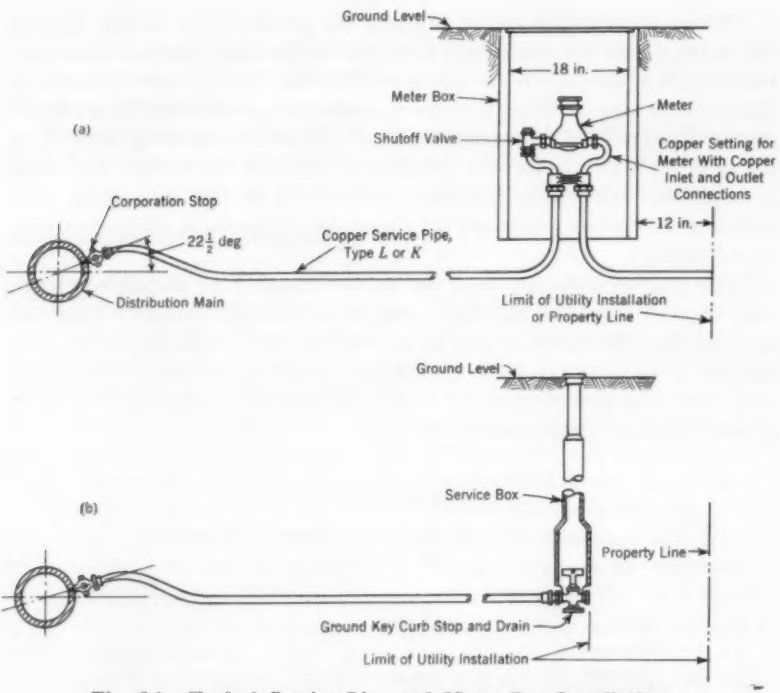


Fig. 6.1. Typical Service Line and Meter Box Installations

Part a *shows a typical service line with the meter at the curb or customer's property line. Part* b *shows a typical installation with a curb box at the curb or property line; the meter, if any, is installed on the customer's premises.*

TABLE 6.2

Computed Friction Losses for ¾-in. Copper Services With ¾-in. Meter

Rate *gpm*	Service Length—*ft*				
	20	40	60	80	100
	Computed Friction Loss—*psi*				
1	0.63	0.91	1.19	1.47	1.75
2	2.20	3.10	4.00	4.90	5.80
3	4.44	6.24	8.04	9.84	11.64
4	7.49	10.49	13.49	16.49	19.49
5	11.05	15.45	19.85	24.25	28.65
6	14.97	20.97	26.97	32.97	38.97
7	19.93	27.93	35.93	43.93	51.93
8	25.54	35.74	45.94	56.14	66.34
9	31.64	44.24	56.84	69.44	82.04
10	39.11	54.71	70.31	85.91	101.51

tained carrying capacity, but they are subject to rapid corrosion under some conditions. This is particularly true of yellow brass. Brass pipe is rigid, requires threaded couplings, and is costly.

Steel, Iron, and Asbestos-Cement Pipe

Black and galvanized-steel pipe and wrought-iron pipe, both unlined and cement lined, have been used successfully for many years. They are rigid, require threading, and, therefore, are not easy to install. They have relatively short lives owing to their susceptibility to the corrosive action of soil and the water inside the pipe, as well as to galvanic corrosion resulting from contact with bronze corporation and curb stops.

Cast-iron and asbestos-cement pipes are used for the larger services, generally in 2-in. size or larger. Both have excellent corrosion resistance and retain carrying capacity well.

Plastic Pipe

Many types of plastic pipe, varying from soft, flexible ones to hard, brittle ones, are becoming more and more available for service line installations. Some types are easy to install with standard fittings and valves; others require special fittings and jointing materials. The ability of various types of plastic pipe to withstand interior pressures as well as outside damage varies considerably. Most plastics are affected by temperature changes. Some plastics impart taste and odor to the water. Some are even toxic to humans and should never be used in potable-water systems. Fabrication of plastic pipe was begun about 1940 and has grown tremendously since 1950. In the beginning it was used only for experimental water service installations, but its use is rapidly becoming more and more common because of its potentially low cost.

Copper Pipe

The development of copper service pipe with practical types of connections has resulted in its wide and satisfactory use. Copper pipe is generally looked upon as a standard for comparison. It is popular for service line installations because it is flexible, easy to install, and corrosion resistant in most soils and has a high sustained carrying capacity. It is not sufficiently soluble in water to be a health hazard.

Brass and bronze fittings can be used with copper without causing appreciable galvanic action. The ends of ductile copper tubing can readily be flared to provide an easy method of attachment to fittings. It can withstand high pressures and can be frozen without failure.

The ground conditions that are not favorable to the use of copper tubing are relatively few, but they are important to recognize. Copper does not stand up well where the soil is permeated with acid mine drainage water. Similarly, cast-iron pipe is adversely affected in salt water marsh

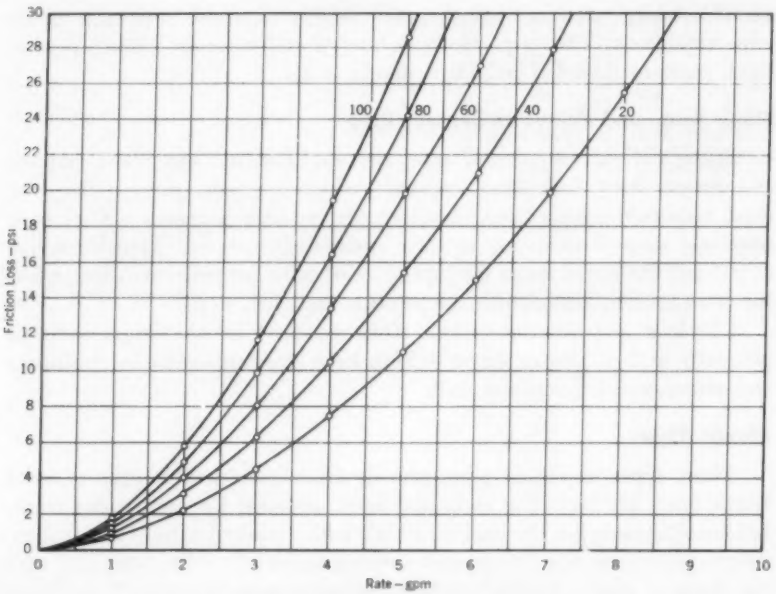


Fig. 6.2. Computed Friction Losses, ½-in. Copper Service With ⅝-in. Meter

Numbers identifying curves indicate length of service, in feet.

TABLE 6.3

*Computed Friction Losses for ½-in. Service Components**

Rate gpm	Fittings and Meter					Pipe Length—ft				
	½-in. Corporation†	½-in. Curb Stop‡	½-in. Globe Valve§	⅝-in. Disc Meter‖	Total, Fittings & Meter	20	40	60	80	100
	Computed Friction Loss—psi									
1	0.09	0.04	0.17	0.05	0.35	0.28	0.56	0.84	1.12	1.4
2	0.28	0.14	0.78	0.10	1.30	0.9	1.8	2.7	3.6	4.5
3	0.55	0.28	1.56	0.25	2.64	1.8	3.6	5.4	7.2	9.0
4	0.92	0.47	2.60	0.50	4.49	3.0	6.0	9.0	12.0	15.0
5	1.35	0.69	3.81	0.80	6.65	4.4	8.8	13.2	17.6	22.0
6	1.84	0.94	5.19	1.0	8.97	6.0	12.0	18.0	24.0	30.0
7	2.45	1.26	6.92	1.3	11.93	8.0	16.0	24.0	32.0	40.0
8	3.12	1.60	8.82	1.8	15.34	10.2	20.4	30.6	40.8	51.0
9	3.86	1.98	10.90	2.3	19.04	12.6	25.2	37.8	50.4	63.0
10	4.77	2.45	13.49	2.8	23.51	15.6	31.2	46.8	62.4	78.0

* Based on friction loss data from standard manufacturers' catalogs.
† Based on equivalent loss of 6.12 ft of ½-in. Type K copper tubing.
‡ Based on equivalent loss of 3.14 ft of ½-in. Type K copper tubing.
§ Based on equivalent loss of 17.3 ft of ½-in. Type K copper tubing.
‖ Based on friction loss curve for ⅝-in. Trident meter (manufactured by Neptune Meter Co., New York).

areas. In these and other limited areas, asbestos-cement pipe or various kinds of plastic pipe may be preferable.

Service Line Material Specifications

AWWA, ASA, and various federal and other organizations have adopted specifications for various materials used in service installations. Some of these have been published by AWWA as an unofficial document for the convenience of its members. These data form part of a committee report entitled "Collected Standard Specifications for Service Line Materials." * Although not a complete summary of materials, the data can be used as a guide for specifying service materials.

Service Installations and Accessories

The method of making service connections at the main varies with the size and material of the service and the size and material of the main to which it is attached. If the size and wall thickness of the main are sufficient to provide adequate full threads, ¾-in. to 2-in. services may be connected by direct drilling and tapping of the main. Tapping machines designed for drilling, tapping, and insertion of the corporation stop under pressure are available.

Tees, wyes, or special branch connections may be utilized for connecting larger service lines. In multiple tapping, corporation stops should be spaced at least 10 in. apart and staggered around the pipe circumference to avoid weakening the main pipe. If the wall of the main is too thin for direct tapping, or if the required number of full threads cannot be obtained, service clamps are necessary. In such cases, drilling is done through a corporation stop which has already been screwed into the service clamp. Larger drilling machines are used to drill through tapping sleeves and valves for making lateral or branch connections to mains under pressure. If the main is out of service, and the service connection is large, it may be desirable to cut the pipe and insert a tee.

The depth at which service lines are laid is of great importance. Additional depth beyond that necessary to avoid freezing and to protect against traffic damage imposes higher installation costs. On the other hand, maintenance costs during severe cold weather can be extremely high. The rate and extent of frost penetration is a function of the character of the soil, snow cover, and the duration and intensity of air temperatures below freezing. Frost penetrates gravel more quickly than clay. Pavements are generally poor insulators, whereas snow cover is a good insulator. Service lines freeze more often than mains, because there is a smaller volume of water to be cooled and longer periods of no water movement.

One problem when expensive pavement is to be installed is to decide whether services should be installed to vacant lots in advance. Generally

* AWWA C800. Am. Wtr. Wks. Assn., New York (1955).

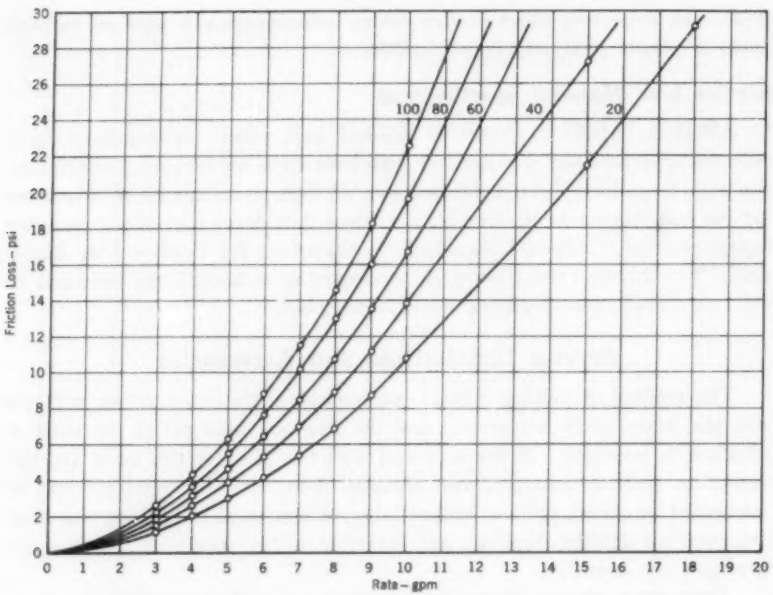


Fig. 6.3. Computed Friction Losses, ¾-in. Copper Service With ⅝-in. Meter

Numbers identifying curves indicate length of service, in feet.

TABLE 6.4

Computed Friction Losses for ¾-in. Copper Services With ⅝-in. Meter

Rate gpm	Service Length—ft				
	20	40	60	80	100
	Computed Friction Loss—psi				
1	0.19	0.24	0.30	0.35	0.40
2	0.55	0.72	0.89	1.06	1.23
3	1.08	1.43	1.78	2.13	2.48
4	2.03	2.61	3.19	3.77	4.35
5	3.02	3.86	4.70	5.54	6.38
6	4.06	5.22	6.38	7.54	8.70
7	5.42	6.98	8.54	10.10	11.66
8	6.82	8.72	10.62	12.52	14.42
9	8.64	11.04	13.44	15.84	18.24
10	10.73	13.73	16.73	19.73	22.73
15	21.41	27.21	33.01	38.81	44.61
20	35.61	45.01	54.41	63.81	73.21

the cost of such advance service connections is paid by the owner of the property. Of course, if the prospective use of such services is far in the future or if changes in lot sizes may make the use of such advance installation impossible, it would be uneconomical to install them.

Typical service line installations are shown in Fig. 6.1.

Hydraulic Considerations

Substantial losses in pressure take place in the customer's service line. These losses can be critical in improperly designed service installations. The sizes of various elements of the service and meter installation should be designed to meet the maximum anticipated demand rate of the customer without incurring excessive friction loss.

The maximum instantaneous demand rate in the average household ranges from 6–12 gpm (two fixtures being simultaneously used). Normal individual household fixture rates are approximately as shown in Table 6.1.

With a ¾-in. copper service line 40 ft long and a ⅝-in. disc meter, the friction loss with a flow of 10 gpm would be approximately 13 psi. If 30 psi is the available pressure in the main, there remains only 17 psi, or 39 ft, to overcome static lift from the cellar to the second or third floor and provide a residual at the fixture. If a 1-in. copper service line is installed, with ⅝-in. disc meter, the friction loss is only 5.5 psi under the same flow conditions. Thus a substantial reduction in friction loss will result without a great increase in cost.

In Fig. 6.2–6.4 are shown normal friction losses, for various service lengths of ½-in. and ¾-in. copper services with a ⅝-in. disc meter and of 1-in. copper services with a 1-in. disc meter. Tables 6.2–6.4 give the computed losses for each component of the installation. In addition to the friction losses in the service pipe, the curves include friction losses through the corporation stop, curb stop, and a globe valve.

Half-inch services are nowadays not generally being installed. The data, however, are helpful in showing why customers should be discouraged from using ½-in. pipe for their portion of the service or for major interior piping. Particular attention is called to the high friction loss through the ordinary type of globe valve usually installed by the customer at the cellar wall. The use of a gate valve instead would materially reduce this loss.

It should be borne in mind that the curves are based upon computed values, and can be expected to differ slightly from actual results. They should, however, be sufficiently accurate to serve as a guide in the selection of service and meter sizes for normal customer demand and pressure conditions.

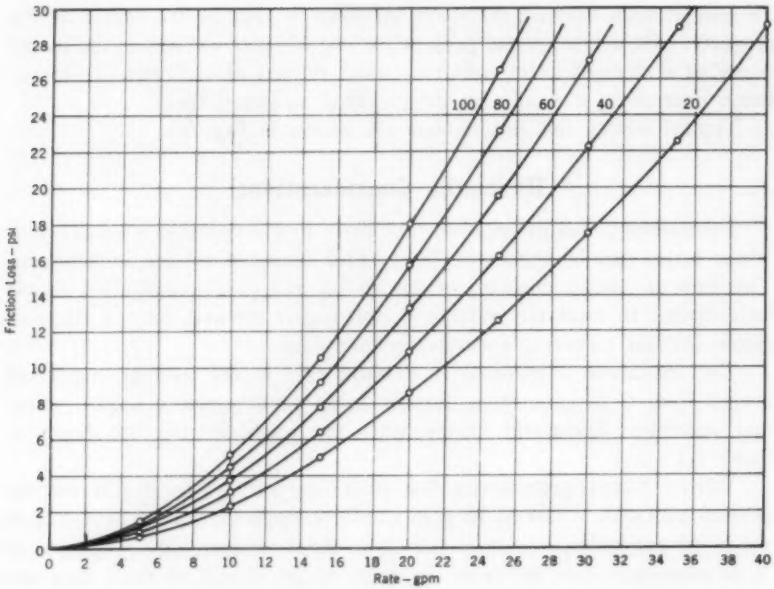


Fig. 6.4. Computed Friction Losses, 1-in. Copper Service With 1-in. Meter

Numbers identifying curves indicate length of service, in feet.

TABLE 6.5

*Computed Friction Losses for ¾-in. Service Components**

Rate gpm	Fittings and Meter					Pipe Length—ft				
	¾-in. Corporation†	¾-in. Curb Stop‡	¾-in. Globe Valve§	¾-in. Disc Meter‖	Total Fittings & Meter	20	40	60	80	100
	Computed Friction Loss—psi									
1	0.015	0.011	0.060	0.05	0.14	0.052	0.104	0.156	0.208	0.26
2	0.050	0.034	0.195	0.1	0.38	0.17	0.34	0.51	0.68	0.85
3	0.103	0.071	0.301	0.25	0.73	0.35	0.70	1.05	1.40	1.75
4	0.170	0.117	0.664	0.5	1.45	0.58	1.16	1.74	2.32	2.9
5	0.246	0.170	0.962	0.8	2.18	0.84	1.68	2.52	3.36	4.2
6	0.340	0.234	1.33	1.0	2.90	1.16	2.32	3.48	4.64	5.8
7	0.457	0.315	1.79	1.3	3.86	1.56	3.12	4.68	6.24	7.8
8	0.557	0.384	2.18	1.8	4.92	1.90	3.80	5.70	7.60	9.5
9	0.703	0.485	2.75	2.3	6.24	2.4	4.8	7.2	9.6	12.0
10	0.879	0.606	3.44	2.8	7.73	3.0	6.0	9.0	12.0	15.0
15	1.70	1.17	6.64	6.1	15.61	5.8	11.6	17.4	23.2	29.0
20	2.75	1.90	10.76	10.8	26.21	9.4	18.8	28.2	37.6	47.0

* Based on friction loss data from standard manufacturers' catalogs.
† Based on equivalent loss of 5.86 ft of ¾-in. Type K copper tubing.
‡ Based on equivalent loss of 4.04 ft of ¾-in. Type K copper tubing.
§ Based on equivalent loss of 22.9 ft of ¾-in. Type K copper tubing.
‖ Based on friction loss curve for ¾-in. Trident meter (manufactured by Neptune Meter Co., New York).

Records

It is of vital importance to maintain a complete record of all services installed in order that they may be located at any future date. There are several methods of maintaining service records. One may employ a service application book in which the applications are numbered and the location of the premises and the applicant's name are given. Usually, however, an index card file is maintained and pertinent information concerning each service installations is posted as it is received. Such information would include the permanent service number, the applicant's name and address, the dates of application and installation of service, sizes of corporation and curb stops used, size and kind of pipe used, depth at which the service is laid, and detailed measurements of the service location. This file may be supported by a large-scale map on which the service is plotted in such detail as is found desirable.

Reprints Available

Reprints of the following articles, published in the JOURNAL during recent months, will be available from the Association in small quantities, at the prices noted, until the present stock is exhausted. Order by reprint number and author's name from: Order Dept., American Water Works Assn., Inc., 2 Park Avenue, New York 16, N.Y. A handling charge of $1 will be added on all orders under $5 unless accompanied by payment in US or Canadian funds or in AWWA Publication Discount Coupons.

Reprint No.	Author	Title	Issue of JOURNAL	No. of Pages	Price per Copy
R1008	CARL	Fire Protection Surveys as Indicators of Water System Status	Apr 60	8	20¢
R1009	PANEL DISCUSSION	Desalinization Processes	May 60	32	45¢
R1010	KOENIG	Well Stimulation Economics	May 60	7	20¢
R1011	EDITORIAL STATEMENT	Style Manual for Journal Authors	May 60	16	25¢
R1012	STUART	Main Extension Policies	Jul 60	8	20¢
R1013	PANEL DISCUSSION	Main Breaks	Aug 60	18	30¢
R1014	BAXTER	Rate-Making Principles	Oct 60	14	25¢
R1015	SWEITZER	Plastic Pipe	Oct 60	12	25¢
R1016	WOODWARD	Pesticides in Water	Nov 60	6	20¢
R1017	PANEL DISCUSSION	Ground Water Recharge	Dec 60	12	25¢
R1018	KOENIG	Well Stimulation Effects	Dec 60	16	25¢
R1019	TASK GROUP REPORT	Status of Fluoridation, 1959	Dec 60	8	20¢
R101	JENKINS	1958 USPHS Inventory	Jan 61	8	20¢
R102	WOLMAN	Desalinization Economics	Feb 61	6	20¢
R103	KOENIG	Well Stimulation	May 61	20	30¢
R104	HERTZBERG, CLARK	Electric Grounding	Jun 61	17	30¢
R105	SYMPOSIUM	Water Quality Data	Jun 61	38	55¢
R106	CHRISTOFFERSON	Steel Tank Coatings	Jun 61	12	25¢

Annual Report of Joint Committee on Uniformity of Methods of Water Examination

A report released in May 1961, by the Joint Committee on Uniformity of Methods of Water Examination, for publication by each of the member organizations.

The Joint Committee on Uniformity of Methods of Water Examination (JCUMWE) completed its fifth year of operation as of Mar. 1, 1961. The committee is made up of representatives of twelve technical organizations engaged in the development and publication of methods of water examination. The objectives of JCUMWE are to review methods of examination published by member organizations to obtain uniformity in sampling, testing, reporting test data, and terminology, and to provide for exchange of information.

The review of methods of examination is accomplished by panels composed of outstanding specialists. When a panel report is approved, it becomes a *preliminary recommendation*, which is then referred to member organizations. After review and study by member organizations, the preliminary recommendation, including approved revisions, is issued by JCUMWE as an *official recommendation*.

Official recommendations have been approved by JCUMWE for reporting of results, total hardness, iron, organic nitrogen, grease and oily matter, solids, and manganese (approved but not yet released). Preliminary recommendations for sulfate, uniformity of reagents, acidity, and alkalinity, including those approved during 1960, are under review by member organizations.

Thirteen panels were active during 1960, covering methods of examination for ammonia; calcium and magnesium; carbonate, bicarbonate, and carbon dioxide; chemical oxygen demand; chloride; dissolved oxygen; electrical conductivity; fluorides; lead; odor; pH glass electrode; total phosphorus; and turbidity.

Four panels were previously authorized, but not activated as of March 1961, for chlorine residual, chromium, nitrite, and silica. New panels were authorized for nitrate and biochemical oxygen demand.

Work was completed on revision of JCUMWE regulations, which will be distributed to member organizations.

The following organizations are members of JCUMWE: American Petroleum Institute, American Public Health Association, American Society of Mechanical Engineers, American Society for Testing Materials, American Water Works Association, Association of Official Agricultural Chemists, Manufacturing Chemists Association, Technical Association of the Pulp and Paper Industry, United States Geological Survey, United States Pharmacopoeial Convention, United States Public Health Service, and Water Pollution Control Federation.

"It's a fact, Joe!

"Every person stopping in our town, even for only a few hours, samples our water...and gets a chance to judge us.

"The clear, fresh-tasting water we serve makes a good impression. It's the best salesman our town ever had."

What about the water supply in *your* town? Does it impress visitors favorably? Do townspeople compare it unfavorably with water they drink elsewhere?

If you aren't sure your water is *consistently palatable,* let AQUA NUCHAR's field representative survey your plant and recommend sound taste-and-odor-control procedures. Simple daily threshold odor tests and the accurately measured use of AQUA NUCHAR controls taste-and-odor at a cost of only a few cents a day.

Why not write or phone us today?

West Virginia Pulp and Paper
INDUSTRIAL CHEMICAL SALES DIVISION

230 Park Ave., New York 17 · Philadelphia National Bank Bldg., Philadelphia 7
35 E. Wacker Dr., Chicago 1 · 2775 S. Moreland Blvd., Cleveland 20

When you open the water meter bids...

ADD UP THE TRUE TOTAL

New Trident Model 60 Sealed Meter

THEN make the best buy...

A water meter should be a lifetime purchase. Its price tag gives only *part* of its cost. Look instead for *true annual costs:*

First, think of revenue loss. A meter returns 12 to 20 times its price before its first check-up. A slight slip in accuracy loses more money than you "save" in a low bid.

Secondly, meters must be tested regularly. One that checks OK *without* repairs obviously is worth more. In the long run, the meter that is *easiest* to repair is also worth more.

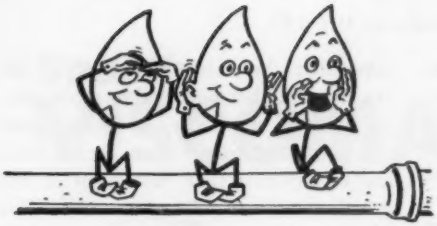
Finally, with most meters you must add obsolescence. But not with Trident. A Trident constantly modernizes itself. All design improvements are made to fit older Tridents too; you get them *automatically* as you insert replacement parts.

Trident meters are designed not for low bid but for low true annual cost. That's why Trident is always your "best buy."

neptune METER COMPANY

LIQUID METER DIVISION
47-25 34th Street, Long Island City 1, N.Y.

OFFICES IN PRINCIPAL CITIES
In Canada: Neptune Meters Ltd.
1430 Lakeshore Rd., Toronto 14, Ont.



Percolation and Runoff

Waterlogged, but a little too often all wet as well, is the nation's press these days. Thus, while we revel in the amount of attention that newspapers and magazines are giving our problems, we can't help being dismayed at the fact that misinformation spreads so much more easily than information and that misinterpretation is so much more dramatic than interpretation.

Somehow at the beginning of the current surge of interest in water supply, the search for angles—for dramatic comparisons—turned up two basic bits of misinformation that have since created a "crisis" and all but provided the "cure."

The "Crisis": Current water use approaches 300 bgd. It is estimated that water use will double in the next 20 years. It is estimated that the total fresh water supply economically available in 1980 will be on the order of 600 bgd. Therefore, we will not have enough fresh water for our needs after 1980.

The "Cure": Domestic water rates range from approximately 20 to 70 cents per 1,000 gal. Costs of desalting water have already been brought down to approximately $1 per 1,000 gal. Therefore, the sea will shortly become a supply source as economical as fresh-water sources now are.

The facts—that water is not only used, but reused; that only about 20 per cent of the amount withdrawn is "consumed" (that is, unavailable for reuse); and that we are now, therefore, using only about 10 per cent of available supply—have not yet caught up with the fancy, and the misinformation continues to get around. Nor have **the facts**—that water rates are not "production cost," but "total cost" of water delivered at the tap; that a cost comparable to the desalting figure would be that of full treatment of a fresh water supply, on the order of 5 cents per 1,000 gal; and that it is generally not the lack of water itself, but the lack of facilities to collect, store, treat, and deliver it to the customer that creates problems—dampened the enthusiasm for the salt water "cure."

The New York *Herald Tribune* in a Jul. 23 Sunday feature on "Our Unquenchable Thirst," provided a lot of good, sound information, including an explanation of "consumptive use" and an estimate that such use would reach 15 per cent by the year 2000, yet went right along to say:

> Most experts have set the year 1980 as the time this country will find itself in real trouble due to fresh-water shortage.

(Continued on page 42 P&R)

(Continued from page 41 P&R)

And in a Sunday, Sep. 3, editorial on "The Quest for Water," the New York *Times*, although it provided assurance that "the population of this country will never suffer from actual thirst," indicated that in 15 years we would be consuming more than 80 per cent of our available fresh water supply. Its answer too was the sea, about which it said:

> A conversion plant at Freeport, Tex., has worked the rate down to about $1, and it has been predicted that the cost could be scaled down in a few years to about 40 cents a thousand gallons. This would be only about 10 cents above the average present rate for the kind of fresh water nature provides.

Fortunately for our optimism about the eventual emergence of the facts, we found in the pages of the science section of the *Saturday Review* for Sep. 2 a discussion of water resources and research which fell into neither trap.

With water at last "discovered," at least the first step toward getting it properly logged has been taken.

Safe Water, Safe World is the essence of an idea that Rolf Eliassen, as one of President Kennedy's advisers on water supply, was giving voice to at the Detroit Conference last June. "Peace through water" was Rolf's phrase, and one of the important steps involved in achieving that end is, of course, health and wealth through water.

In India, for instance, many of the 440,000,000 population are plagued by continued illness and so debilitated that they cannot do the hard work necessary for economic progress. Prime Minister Nehru has expressed the hope that the safe-water goal of his new 5-year plan will enable more people to enjoy the luxury of feeling good and will add many more years to a life expectancy that has risen in the last decade from 32 to 42 years. Give us a good water supply in every village, one visiting Indian official has said, and we will stop communism cold. But India has 558,000 villages and only about 11,000 of them have been provided with piped water supplies. The new 5-year plan is expected to provide supplies for an additional 67,000 villages, but that will still leave 480,000 villages dependent upon raw surface water or water from unsanitary wells. Thus, listed among the prime diseases of the nation is cholera, which in only two of north India's states last year accounted for a death toll of 5,500.

In Egypt the story, if not the disease, is the same. There bilharzia—an endemic disease caused by parasite worms that sap the body strength and eventually lead to death—is the specific result of unsafe water supplies. And it is estimated that 60 per cent of the population suffers from the disease, which is spread by infected snails in the surface waters used as sources of drinking water.

From south China, meanwhile, have come reports of a cholera epidemic already estimated to have killed 30,000 residents of Kwantung Province. And while Hong Kong, Formosa, and the Philippines are rushing to give their people anticholera inoculations, Peiping has attributed the epidemic not to unsafe water supplies but to US bacteriological warfare, the antidote for which is, obviously, not better water supplies.

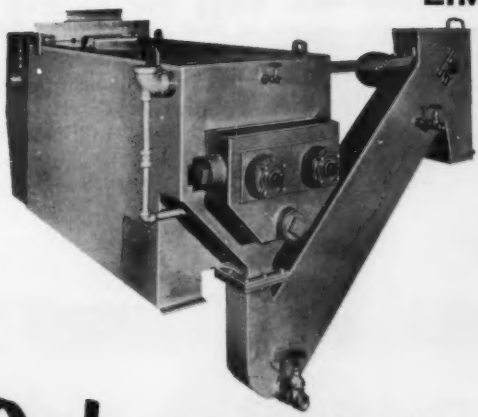
•

(Continued on page 44 P&R)

Specify

VISCOMATIC®

LIME SLAKERS!



CUT SLAKING TIME

SAVE ON LIME

Only INFILCO

has the experience gained from the manufacture and installation of many automatic torque controlled constant viscosity lime slakers.

PROVED IN PERFORMANCE

The "VISCOMATIC" Slaker slakes lime as a paste with true pug mill action...slakes fast with cold water...provides maximum hydrate availability.

Torque actuated water controller maintains constant viscosity ...assures proper slaking with little attention...eliminates temperature controls, water metering and insulation.

Write for INFILCO Bulletin 255. It describes the "VISCOMATIC" Lime Slaker and its utilization in water, waste, and process applications.

G91

INFILCO

INFILCO INC.

General Offices—Tucson, Arizona

Field offices throughout the United States and other countries.

(*Continued from page 42 P&R*)

But it is not necessary to go that far afield to find unsafe water supplies, disease, and poverty. Throughout Latin America they follow each other around. And where they are, there, too, most often, is the threat of communism. Certainly unsafe water is not the cause of communism, but perhaps in our all-out drive toward achieving "quality water" at home, we might give a fleeting thought to the value of making the world's water safe for democracy.

Vintage water has just been reported from "the ends of the earth." First from the polar continental shelf in the Canadian Northwest Territory comes word of the development of water supply from ice, requiring a source at least 3 years old. Younger ice, it appears, produces water much too salty to be palatable. Then from the Saudi Arabian desert has come word that the deep well waters used for supply yield a beverage ranging from 20,000 to 25,000 years of age according to carbon-14 determinations. Eskimo or Arab, though, water is for you!

On their element, above, are two AWWA past-presidents as snapped by a third while cruising on North Saluda Reservoir, new facility of the Greenville, S.C., Water Works, following the Southeastern Section meeting last April. In the picture, left to right, are exprexy Tom Veatch, Spec Bowles of Black & Veatch, exprexy Caesar Wertz, and Ed Farmer also of B&V. Behind the camera was exprexy Paul Weir, and behind the wheel, exdirector Johnny Hawkins, Greenville's general manager. On top of their job, all of them!

J. Allan Hammes was honored by the city of Sheboygan, Wis., on the occasion of his retirement as assistant secretary of the Board of Water Commissioners. He was associated with the city's water department for 49 years and was the city's oldest employee in years of service. Since 1939 he has represented the Board in AWWA.

(*Continued on page 46 P&R*)

when you invest get the best!

PATENTED SILICONE STUFFING BOX PACKING

Split case or frost proof

lower maintenance

WATCH DOG

greater accuracy

Offices in principal cities

GAMON METER DIVISION

NEWARK NEW JERSEY

WORTHINGTON

(Continued from page 44 P&R)

'The Willing Water Stake' is strictly horsemeat—and walking horse at that, but with Henrietta Cramer (Mrs. AWWA Prexy), Willing Water himself, AWWA member Griffin Pipe Div, and $500 all involved, who are we to raise questions? And the horse, and the rider (Charles F. Brown of Joplin, Mo.), and Henrietta, and the trophy, all shown below at the presentation at Ak-Sar-Ben Coliseum in Omaha, Neb., on Sunday, Jul. 30, are, we think, pretty. Actually, we were going to make a fuss about a "walking horse" stake named after Willing, who is certainly "running," Water. But publicity is always welcome publicity and we wouldn't have said a word if they had made the trophy in the form of a horse trough. After all, you can lead a horse to Water, but he's got to be willing to drink!

A remote reading system for water meters that operated for 7 years without giving a bit of trouble was described last month by its inventor,

(Continued on page 48 P&R)

FORT LAUDERDALE • ST. PETERSBURG • FORT MYERS • NAPLES • GAINESVILLE • "MARINELAND" (ST. AUGUSTINE)
WEST POINT • MARION • JACKSONVILLE • EVANSTON • MOLINE • GRANITE CITY • VANDALIA • MATTOON • ALTON • FR
STREATOR • EAST ST. LOUIS • WILLIAMSON COUNTY • INDIANAPOLIS • BEDFORD • GENERAL MOTORS (INDIANAPOL
RICHMOND • COUNCIL BLUFFS • CENTERVILLE • DAVENPORT • DUBUQUE • CRESTON • HUMESION • WEST DES MOINI
OSAGE CITY • BELOIT • GRENOLA • KANSAS CITY • ATCHISON • ELLSWORTH • MANHATTAN • HAYS • TOPEKA • OLAT
WICHITA • ALTAMONT • LAWRENCE • MORRIS • ST. PAUL • FT. SCOTT • EUREKA • DESOTO • LAWRENCE • RUBBER RES
PRINCETON • OWENSBORO • HOPKINSVILLE • LEXINGTON • U.S. ARMY (FORT CAMPBELL) • JEFFERSON COUNTY •
BELLE CHASSE • LAKE CHARLES • SHREVEPORT (CROSS LAKE PLANT) • ALEXANDRIA • EMPIRE • KAISER ALUMINUM
KAISER ALUMINUM CO. (CHALMETTE) • SHREVEPORT • METAIRIE • MARRERO • LOGANSPORT
BEL AIR • HAVRE DE GRACE • WESTMINISTER • ROCKVILLE • YPSILANTI • FILER
WYANDOTTE • ALGONAC • HIGHLAND PARK • FAIRMON
VICKSBURG • JACKSON • MARSHALL • PLA
EXCELSIOR SPRINGS • RICHMOND •
IRONTON • CARROLLTON • GREAT FALLS •
LINCOLN • OMAHA • ROCTON • TOR
FREDONIA • BELLEFONTE • NFORD • LILLI
CORNING • ALBANY • FIN • AVON LA
WINDHAM • JAMESTOWN • ON • ELYRIA •
McALESTER • ORE • DURANT
WILKINSBURG • R HOME (EVA
FREDERICKTOWN • ALD • ALIQUI
READING • GUTHRIE • DOMSBURG •
CARMICHAELS • ASURE ISLAND POOL
HILLMAN COAL • UNION CITY • CHARLEROI •
NEW KENSINGTON • SHARPSVILLE • MONONGAHELA •
LETTERKENNY • INGTON • LEWISTOWN • NEW CASTLE •
BEAVER FALLS • MARCUS HOOK) • QUARRYVILLE • BRECKENRIDGE • RED
EVANS CITY • TARENTUM • ND COUNTY • EDGEFIELD • WALHALLA • MOBRIDGE • CLARK
SEVIERVILLE • FRAYSER • CHATTANOOGA • CHAVEN • JEFFERSON CITY • SEWANEE • HARRIMAN • HUNTINGDON
BORGER • NAVY BASE, (CORPUS CHRISTI) • LAREDO • RUBBER RESERVE CORP., (BORGER) • SYNTHETIC RUBBER P
PHARR • MONTE ALTO • BROWNSVILLE • DONNA • SAN ANGELO • BEAUMONT • FORT WORTH • LLANA • MARSHALL •
ELECTRA • SWEETWATER • WICHITA FALLS • WESLACO • BAIRD • IOWA PARK • ABILENE • PORT ARTHUR • SAN BEN
HOUSTON • STAMFORD • RIVER OAKS • WACO • RIO GRANDE CITY • GULF OIL CORP. (WEST PORT ARTHUR) • SP
EAGLE PASS • PHILLIPS CHEMICAL CO. (HOUSTON) • ALBANY • WEATHERFORD • INDUSTRIAL FILTER CO. (HOUSTO
IOWA PARK • NORFOLK • PORTSMOUTH • AMERICAN VISCOSE CORP. (FREDERICKSBURG) • AMERICAN VISCOSE
NEWPORT NEWS • WHEELING • MATEWAN • CHARLESTON • WEIRTON • AMHERST COAL CO. (LUNDSDALE) • MT. HO
MOOREFIELD • LOGAN • MONONGAH • RICHWOOD • FAIRMONT • KINGWOOD • NORTH FORK • PHILLIPI • NITRO • RIPLE
HANCOCK COUNTY • AMHERSTDALE • ALDERSON • HARRISVILLE • KERMIT • MILTON • STATE COLLEGE (LIBERTY) •
APPLETON • RACINE • LOVELL • WORLAND • CHEYENNE • JOLIETTE • VANCOUVER • CORNWALL • GRIMSBY • NIAGARA

These ~~464~~ 495 plants* know . . . the list keeps growing!

How to get to the bottom of backwash problems

The best way is to install Leopold Glazed Tile Filter Bottoms, just as all these plants have done.

Like them, you'll find Leopold Bottoms successfully meet all underdrain requirements. The individual Leopold blocks can't corrode or absorb water . . . are acid and alkali resistant . . . are not subject to tuberculation . . . and provide equal filtration and uniform wash distribution. In addition, because Leopold Bottoms won't wear out and assure minimum media maintenance, they are the most economical in the long run.

We'll be glad to supply facts and figures without obligation.

**Including over 100 rehabilitation projects*

F. B. LEOPOLD CO., INC.
ZELIENOPLE, PA.

Leopold

(Continued from page 46 P&R)

Charlie Green of Billinghay, England. Green, who was meter reader and maintenance man for the local utility for 15 years, spent the first 8 years of his tenure developing not only the incentive, but the background data upon which his system was based. Then, when he decided that he had had enough of trudging along a hundred miles of mains to seek out meters located in pigsties, haystacks, and other odd places, he instituted his remote reading system unannounced. And it wasn't until a couple of high-bill complaints came through last month that its use was revealed.

Now Green is working as a foreman at a poultry packing station, and undercharged customers have paid the utility $5,240 in back charges. And a bill for $450 in uncollectibles which he is to pay will thus become the only cost of Charlie's 7 years of complete rest.

Incidentally, if our punctuation and sentence structure in future issues appears rather haphazard at times, please don't mention it.

(Continued on page 50 P&R)

This Month Years Ago

October 1886—A microphone was used in Germany for the purpose of detecting loss of water through leakage in mains. "A leak of even a few drops through a badly fitting cock causes sufficient vibration in the pipe to affect the microphone."

Wind reaching the velocity of about 80 mph hit Victoria, Tex., which had a reservoir or standpipe 16 ft in diameter and 100 ft in height. The iron was $\frac{1}{2}$ in. thick for the first 70 ft and $\frac{3}{16}$ in. for the remaining 30 ft. During the storm this pipe was swayed back and forth and finally collapsed.

October 1911—According to a report made to the board of trustees of the sanitary district of Chicago by George M. Wisner, chief engineer, "steps should be taken to protect the intakes of the water supply against sewage from vessels inside the harbor or its entrance. Regulations should be established and rigidly enforced covering the construction of tanks to carry the refuse, or else the closets should be locked while the vessels are within a minimum distance of, say, 5 mi from shore."

"It should be distinctly understood that there is no such thing as a self-cleaning (domestic) filter. On the whole, we may conclude that it is clearly the duty of every community to supply a pure wholesome water, so that domestic filtration may not be necessary."

At the Metropolitan Water Works in Boston, Mass., an 80-in. main was lined with 2 in. of Portland cement mortar poured in forms.

"The physical structure of man does not seem adapted to drinking upward. It is as good as a circus to watch the novice trying one of these new-fangled fountains. There is always an exciting uncertainty about whether the squirt will seek entrance at the eye or at the nose."

"The man who delights in himself tinkering with his gas and water pipes will be interested in the 'lead wool' which is now being used for the purpose of making tight joints without the use of hot lead. This soft, fibrous material will make a joint that is . . . flexible as well."

NOW AVAILABLE TO KENNEDY A.W.W.A. VALVE USERS...

Complete factual information on KENNEDY A.W.W.A. VALVES and HYDRANTS

• *Write on your letterhead for your copy to:*

KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK

• OFFICE AND WAREHOUSES IN PRINCIPAL CITIES

DUCTILE IRON VALVES • CAST IRON VALVES • BRONZE VALVES • INDICATOR POSTS • FIRE HYDRANTS

HAVE YOU SEEN

HAYS®

METER STOPS

¾" Fig. 25014
Straight Meter Stop
Meter Swivel Nut (for ⅝" x ¾"
or ¾" Water Meter) x ¾" Copper
Service Connection.
¾" Fig. 25015
Straight Meter Stop
Meter Swivel Nut (for ⅝" x ¾"
or ¾" Water Meter) x ¾" Female
Iron Pipe.

- Roundway, Solid Bronze Tee Head.
- Use on either inlet or outlet of meter.
- Write for more information or Ask the Man from Hays on his next call.

GENERAL PRODUCTS DIVISION

HAYS MFG. CO.

ERIE, PENNSYLVANIA

(*Continued from page 48 P&R*)

The Age of automation having arrived in an unwelcome extirpation of employment classifications, it is good to note that at least one new job opportunity has been, or surely will be, created by its arrival. The supplementary post in the field is that of "water works sitter," the need for which was very clearly established by the events of Jun. 24, 1961, in the village of Bistrup, Denmark. Bistrup has—or, rather, had—a completely automated, unmanned water works, doing a fine job of providing the residents of that Copenhagen suburb with quality water. Then one evening three men appeared in a truck and stole not only the water works machinery, but the building as well, while the unman said not a word. When the inspector showed up not much later the water was still there. There was, in other words, no water shortage but a shortage of facilities to get it where it was needed when it was needed. And all of Bistrup bist!

War, no doubt, will be much more hellish in the future than ever before. But at least the warrior of tomorrow will be spared one of the major horrors of the past, thanks directly to "just add water." Specifically, it will be thanks directly to "just add water" that the mess sergeant will be depotentiated. Already the army has made available 21 different precooked and dehydrated "Quick Serve Meals" to which the messman need only add boiling water. And even though there will be those who haven't yet learned how, their capacity for harm will certainly be minimized.

In peace or war, "just add water" and life will become easier.

(*Continued on page 52 P&R*)

"The service is rough, but we've never experienced a pump failure since the first Peerless pump was installed in 1932."

Says Farrell McLean, Water Superintendent Carlsbad, New Mexico

This is one of the ten Peerless Deepwell Turbine Pumps used to supply the entire city water supply. Pump setting is 80' with 1800 GPM flow.

First installed in 1932, this Peerless pump is still on the job. Like the other nine pumps, this unit is handling water with 50 grains total hardness per gal.

Pumping water with 50 grains of Total Hardness per gallon is rough service in anybody's language. Yet that is exactly what Peerless Deepwell Turbines have been doing, better than 28 years for the city of Carlsbad, New Mexico. The first installation was made in 1932. And, through the years, nine more units have been added to the field to meet the city's increasing water needs. The pumps are operated on continuous duty for periods ranging from four to six months and semi-continuous duty the balance of the year. To date they have never had a pump failure and even the regular maintenance programs call for pulling pumps only every six to seven years for inspection. For the complete story on Peerless Deepwell Pumps, write us.

PEERLESS PUMP

HYDRODYNAMICS DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

301 WEST AVENUE 26, LOS ANGELES 31, CALIFORNIA

(Continued from page 50 P&R)

EJC has recently moved its offices to the new United Engineering Center (see cut below), with its official address at 345 E. 47th St., New York 17, N.Y. Other groups joining the council in the new headquarters facing the United Nations include AIChE, AICE, AIEE, ASCE, and ASME.

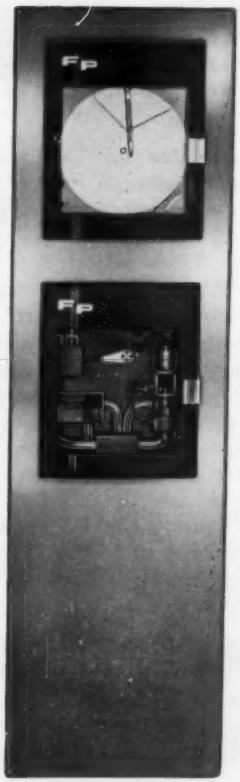
NIMS—not a new society—is simply the Post Office's term to refer to its nationwide improved mail service program. In order to facilitate the fast handling of important mail, the Post Office is asking large mailers to separate mail according to its importance. Priority mail, deposited in the late afternoon, will be handled first, assuring prompt dispatch and quicker delivery. Non-priority mail, held over for deposit the following morning, can be sorted and handled during the slack daytime period. All mailers are asked to deposit as much mail as possible during the morning hours.

The hose dive routine, which every year inspires new stories and pictures from all parts of the country about garden hoses that head for China and won't be unbrainwashed, has finally inspired someone to accomplish something entrepreneurish. Blaine E. Eynon is the man. As president of a Detroit manufacturing firm, Blaine read those stories and saw those pictures of struggling hose owners and did something about it. He invented a water-powered drill consisting of a 4-ft length of aluminum tubing with a special drilling nozzle on one end and a hose connection on the other. The drill can be used to saturate roots of trees or to fertilize them—or just to drill 4-ft deep holes in your lawn. At any rate, the drilling action of the water carries the nozzle down at the rate of 4 fpm. Just be quick about turning it off!

Edward E. Alt has retired as a sales representative of Chicago Bridge & Iron Co., after 43 years of service with the firm. He will be retained by the company as a consultant. A former chairman of the Illinois Section, he is also a past-president of WSWMA. He has been selected twice as an AWWA Director, representing the Illinois Section in 1954–57 and currently representing WSWMA. He was chosen by the section to receive the Fuller Award in 1956.

(Continued on page 54 P&R)

■ Here is the **Anachlor*** – the residual chlorine analyzer that's also an efficiency expert on water or sewage treating operations. It continuously measures Cl_2 residuals, frees personnel from routine checks, and saves on the cost of treatment chemicals. The Anachlor has two basic components, the analyzer unit where current proportional to the chlorine is generated, and the recorder or indicator with optional electric or pneumatic control elements. It can trim chlorinator feed rate and also transmit measured values to a remote station. It employs an electrode rotating at high speed so that a high velocity of sample flow is not necessary. The electrode cell is easily disassembled for cleaning by disconnecting one slip-on connection and two pins. You'll find the Anachlor equally suitable for water or sewage treating operations – easy to operate – easy to maintain – and thoroughly dependable.



The Anachlor is described in complete detail, from operating principles to control options, in Catalog 17B2200. This instrument is only one of many F&P components for automating water and waste treatment. For basic information or specific suggestions write Fischer & Porter Company, 1001 Fischer Road, Warminster, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2808 Jane Street, Toronto.

FP
FISCHER & PORTER COMPANY
CHLORINATION AND INSTRUMENTATION

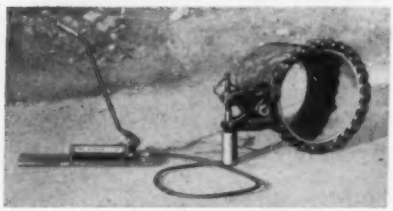
*Anachlor is a trade name of Fischer & Porter Company

NOW AVAILABLE!

THE WHEELER

"SUPER"

HYDRAULIC PIPE CUTTER



for 10" thru 20"
CAST IRON WATER MAIN

No rotating—all you do is wrap the chain around the pipe, engage it in the cutter's upper jaws, adjust out slack and operate pump.

JUST
SQUEEZE AND POP!

For pipe sizes up to 12" we recommend our Heavy-Duty Hydraulic shown here in the act of cutting a section of large diameter pipe.

The Wheeler Mfg. Corp.
P. O. Box 688
Ashtabula, Ohio

(*Continued from page 52 P&R*)

Water on the brain is necessary for clear thinking these days, but brain food is strictly for the birds—the seagulls, kingfishers, and heron, that is. All of which means, of course, that the clear thinking is done by electronic brains. What else? And the water on it is for cooling the hundreds of electronic cogitating components. It was the $3,000,000 brain at the Armour Research Foundation of Illinois Institute of Technology that was fed up last month, when the Chicago public water supply, used to keep it under control, delivered a mess of fish, up to 1 in. in length, through the cerebral service line. The brain stopped thinking—almost blew a fuse—until the minnows were eliminated. Probably thinking about vacation.

A manatee for Lititz was called for on the editorial page of the Lititz *Record-Express* on the recommendation of P&R (Feb., p. 44) when eight Peking ducks imported to keep the algae out of the Pennsylvania town's park trout stream proved to prefer bread crumbs proferred by Lititzians to the gucky slime they were bought to eat. The issue—of the mama and papa algae, that is—which commanded headlines for months were still unresolved and uneaten in June, presumably because Borough Manager Dave Bauer, an AWWA member, had not yet been successful in propositioning a mermaid.

Chester A. Ring has been appointed chief engineer of the Elizabethtown Water Co., Elizabeth, N.J. He was formerly chief engineer of the Plainfield-Union Water Co., which recently

(*Continued on page 56 P&R*)

in Badger's *Easy-Read** sealed register

Look into the workings of this Badger Easy-Read magnetic drive meter. Its instrument gearing is smaller, lighter in weight, lower in friction than ever before possible.

Neither water leakage nor corrosion makes demands on the mechanism. Magnets rotate on ball bearings, so the gearing turns freely with practically no resistance. With friction reduced, Badger Easy-Read can maintain accuracy far longer.

Call or write your Badger representative and ask him to give you a personal demonstration of the new Badger Easy-Read magnetic drive meter.

The new Easy-Read can be ordered in split-case (⅝" thru 2") or frostproof models (⅝" thru 1" x 1¼").

*Trademark

Badger Meter Mfg. Company

4545 West Brown Deer Road • Milwaukee 23, Wisconsin

(Continued from page 54 P&R)

merged with the Elizabethtown company.

Ralph B. Carter, founder and chairman of the board of the Ralph B. Carter Co., of Hackensack, N.J., died on Aug. 21, 1961, at his home in Melbourne Beach, Fla. He was 94 years old. Formerly president of the firm, he had been living in Florida for 30 years.

William C. Gibson, associate dean of the School of Public Health at the University of Michigan, died on Aug. 17, 1961, in Ann Arbor, Mich., at the age of 46. A graduate of New York University (1936) and the University of North Carolina (1950), he joined the faculty at the University of Michigan in 1950 as associate professor of public health engineering. In 1956 he was promoted to professor.

A member of AWWA since 1949, he was also a member of APHA and a diplomate of the American Academy of Sanitary Engineers.

Harold E. Orford, professor of Sanitation at Rutgers University, New Brunswick, N.J., died on Jul. 10, at the age of 47. Born in Cleveland, Ohio, he received his B.S. degree from Case Institute of Technology in 1936. He joined the Rutgers faculty in 1938, after receiving his master's degree from the university. He earned his doctorate at New York University.

A member of AWWA since 1954, he was also a member of ASCE, WPCF, and the American Society of Professional Engineers.

WILEY BOOKS

UNIT OPERATIONS OF SANITARY ENGINEERING

By L. G. RICH, *Clemson College.* A rational approach to the design of unit operations, this book unifies basic principles to provide greater coherency in the theoretical development of design relationships. It considers many operations not ordinarily covered in sanitary engineering books, including: aerosol separation; gas transfer in packed tower and tray columns; heat transfer; evaporation; and drying. Chemical engineering notation is used throughout. *1961. 308 pages. $10.75*

Send now for your on-approval copy

JOHN WILEY & SONS, Inc.

440 Park Avenue South, New York 16, N.Y.

HYDRAULIC CALCULATOR

For the determination of friction loss, flow, velocity, pipe size, "C" value, and 1.85 h/Q factor. Based on Williams and Hazen formula. Consists of two circular plastic discs and indicator arm. Pipe sizes range from 4" to 72". Overall size of calculator is 6". Instruction booklet included.

For immediate delivery, send $6.00 to

Robert E. Martin
Consulting Engineer
5402 Preston Highway
Louisville 13, Kentucky

Layne pumps top more producing water wells

Layne Pump Design, manufacture and installation are only part of the complete water service offered by the Layne organization. Other services include: Initial surveys, explorations, recommendations, site selection, foundation and soil sampling, well drilling, well casings and screens, gravel wall wells, construction of water systems, complete research staff and facilities, maintenance and service, chemical treatment of water wells, water treatment. *Write for Bulletin No. 100.*

World's Largest Layne Water Developers

LAYNE & BOWLER, INC., MEMPHIS

General Offices and Factory . Memphis 8, Tennessee

Water Wells • Vertical Turbine Pumps • Water Treatment

ION EXCHANGE APPLICATIONS

A *Nalco*® Expert Answers Questions About an Economical, Efficient Method of Municipal Water Demineralization

F. K. Lindsay, Product Manager, Ion Exchange Department

The use of ion exchange resins to reduce hardness of municipal water supplies has become more and more common as an ever increasing number of communities have come to realize the benefits of this modern, economical method of water softening. Here are a few of the more common questions answered for you by F. K. Lindsay, Nalco expert on municipal ion exchange applications.

Question: **Can ion exchange softening be used to reduce hardness of any municipal water supply?**

Answer: Yes, though ion exchange may be more economical under some conditions than under others. For example, when quantity demands are great, high bicarbonate waters are sometimes more economically treated with lime. When only moderate demands are made on the system, however, ion exchange processes are not only simpler, but less expensive, and are particularly suited to intermittent operation. Whether or not ion exchange can be used to advantage in a given system can be determined from a detailed analysis of that system—an analysis which can be made by a Nalco ion exchange specialist upon request.

Question: **Do ion exchange softening processes work efficiently on water supplies containing iron?**

Answer: Ion exchange can be used to treat iron bearing water. However, it is often desirable in such cases to first remove the iron by an oxidation and filtration process, so that both the water passed through the resin beds, and the blending water used for control of hardness at the mains, are iron free. The city of Pella, Iowa, has such a system, where iron removal and ion exchange softening are carried on automatically to keep the hardness level at no more than 5 grains per gallon. Ground water is pumped through an aerator and passed through gravity sand filters, which remove oxidized iron. Part of this iron-free water flows to open gravity beds containing Nalcite® HCR-W® cation exchanger and the balance of the filter effluent is blended with the exchanger effluent to maintain exact hardness control. The resin beds are regenerated at a low salt dosage, and automatic titrators control the point at which the regeneration takes place. When the storage tanks and stand pipe are full, the well pump stops and the plant remains idle until more water is needed. If the iron removal plant were not used, the ion exchange beds would require heavier salt dosages and periodic cleaning.

IN MUNICIPAL WATER SYSTEMS

Question: Can ion exchange be used to lower cost when lime-soda treating?

Answer: Yes. Water now requiring large quantities of soda ash can be treated economically by eliminating soda ash and following lime-treatment with ion exchange. This process is used by the Village of LaGrange, Illinois, where high sulfate hardness water is treated first with lime to reduce carbonate hardness and remove iron, and the lime treater effluent (at a 20-grain hardness level) is filtered, and passed up-flow through Nalcite HCR® cation exchange open gravity resin beds. The "Zeolite" softened water is then blended with filtered lime-treater effluent to maintain hardness at a 5 grain per gallon level. Salt consumption amounts to 0.25 pounds per kilograin of hardness removed from the filtered lime-treated water.

Question: Many municipalities draw their water from several wells. How can ion exchange be used in such cases?

Answer: If the water supply does not contain constituents that will foul ion exchange resin beds, automatic water softeners and blending controls can be placed at each source. Operation is automatic—water flowing from each well is reduced in hardness to the desired levels, and contact meters determine the need for regeneration.

Question: Can sea water be used to regenerate ion exchange resins?

Answer: Yes. Nalcite HCR or Nalcite HCR-W cation exchangers can be regenerated with sea water to produce capacities of 15,000 to 18,000 grains per cubic foot. However, sea water must be adequately filtered, and usually chlorinated, to prevent contamination of resin beds. The sea water is pumped up-flow through the resin beds, similar to a backwashing process, and the flow is then reversed to pass the sea water down-flow through the bed. About fifty gallons of sea water per cubic foot of resin bed will provide effective regeneration. The city of Jacksonville Beach, Fla., operates a plant of this kind to soften a well-water supply, using pressure-type equipment which is automatically regenerated with sea water on a gallonage basis.

Brine wells can also be used to regenerate resin beds if the salt content is sufficiently high to provide effective capacities. A two per cent or greater concentration is desirable, although wells containing as little as 0.75 per cent NaCl have produced about 8000 grains capacity per cubic foot.

Question: What are the advantages of using Nalcite ion exchange materials?

Answer: Quality resins and expert technical assistance on ion exchange. Nalcite ion exchange resins are produced by the Dow Chemical Company for Nalco Chemical Company, and are available from leading water conditioning equipment manufacturers. These resins are produced in carefully controlled manufacturing processes, during which small, weak, and cracked beads are virtually eliminated. The result is a water softener made up of tough, long-lasting ion exchange resin beads. And, as with other Nalco products, Nalco experts are at your service, to help you analyze and solve your water conditioning requirements. For information about water conditioning with Nalcite ion exchangers, write to Nalco for Bulletin Z-5.

Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES
Nalco CHEMICALS
Nalco SERVICES

NALCO CHEMICAL COMPANY
6216 West 66th Place • Chicago 38, Illinois
Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany
In Canada: Alchem Limited, Burlington, Ontario

Nalco®

...Serving Industry through Practical Applied Science

CHEMICAL RESEARCH ENGINEER

Chemical Engineer, MS preferred, with 3–5 years experience, reporting to Manager of Research. To apply chemical engineering principles to the water and waste treatment field. Supervise and evaluate experimental work and prepare feasibility studies. New staff being recruited by nationally-known, progressive company.

Send resume and salary requirements to The Permutit Company, 50 West 44 St., N. Y. 36, N. Y.

Manager of Research

Advanced degree in Sanitary or Chemical Engineering with 10 years' experience in water and waste treatment or related field. To direct R&D program of nationally-known, progressive company. Will select own staff (ultimately 15 to 20). A man of recognized professional standing and administrative ability is required, to originate and apply new methods and procedures to the development of new processes and equipment designs.

Send resume and salary requirements to The Permutit Company, 50 West 44 St., N. Y. 36, N. Y.

Employment Information

Classified ads will be accepted only for "Positions Available" or "Position Wanted." Rate: $1.50 per line (minimum $5.00), payable before publication. Deadline for ad copy: first of month prior to month of publication desired. To place ad, obtain "Classified Ad Authorization Form" from: Classified Ad Dept., Journal American Water Works Assn., 2 Park Ave., New York 16, N.Y.

Positions Available

CITY OF MILWAUKEE. Chemist II: $6612 to $7920, and Chemist I: $5808 to $6912. College graduates with bachelor of science degree in chemistry or chemical engineering, including bacteriology. Four years' experience for Chemist II, and two years' experience for Chemist I in analytical chemistry or bacteriology laboratory. Apply immediately to Examining Division, City Service Commission, Room 701, City Hall, Milwaukee 2, Wisconsin.

WATER PLANT SUPERINTENDENT
WATER DISTRIBUTION SUPERINTENDENT

Mid-Western university city of 40,000 population is accepting applications for the above positions. The city has recently assumed operation of the water utilities, and the positions offer a real challenge for competent and experienced men. Salary open, liberal vacation, sick leave, etc. Apply: Box 1101A, Journal American Water Works Assn., 2 Park Ave., New York 16, N.Y.

Water Utility District Manager. Man with experience in the administration of a commercial office as well as field and plant operations. Salary range $7,500–9,000. An excellent opportunity to become associated with an expanding water authority in one of the fastest growing counties in the country. Interview will be arranged on the basis of resume submitted. Write:

Suffolk County Water Authority
P. O. Box 37
Oakdale, Long Island, New York

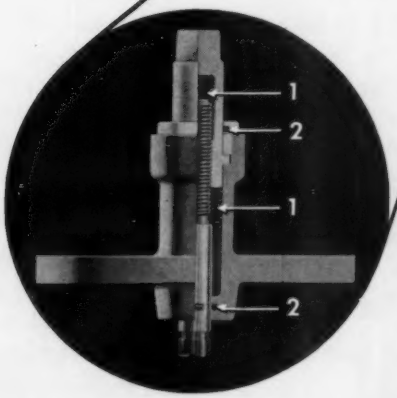
WATER AND GAS DISTRIBUTION

The City of Hamilton, Ohio, population 73,000, is now recruiting for a water and gas distribution engineer. To qualify you must have experience in water and/or gas distribution. Applicants should be capable of professional registration in Ohio. Age 25 to 45. The position offers good pay, an excellent fringe benefit program and a definite opportunity for advancement, as our present superintendent of water and gas distribution is nearing retirement age. Send brief resume to Harold A. Hart, Civil Service Director, City of Hamilton, Ohio.

Please do so at once.

WHAT'S INSIDE? A BIG PLUS

AUTOMATIC LUBRICATION AND DOUBLE "O" RING SEALS



Smith Fire Hydrants are easy to operate, inexpensive to maintain and most dependable in meeting severe climate and operating conditions. In addition to maximum flow and simplicity of design, Smith Hydrants now have two additional features of major importance: (1) Automatic lubrication — chamber sealed with "O" Rings contains a permanent type lubricant — temperature range–30° to 200°F. Each time the hydrant is operated, the threads and bearing surfaces are automatically lubricated. (2) "O" Ring Seals — the lower "O" Ring seals the internal pressure, the upper "O" Ring is a combined external dirt and moisture seal. This construction eliminates the conventional stuffing box and packing gland adjustments.

65

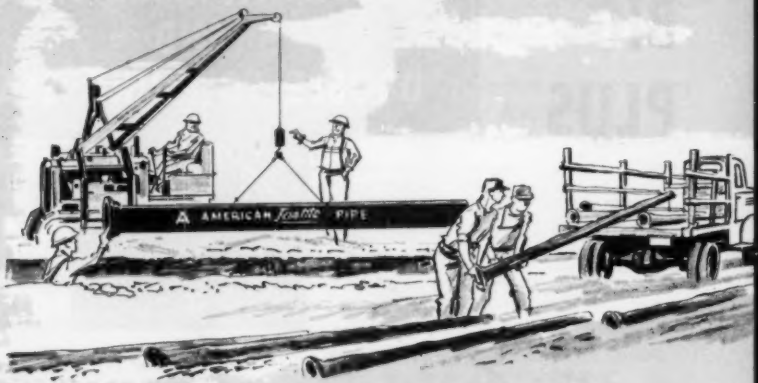
FIRE HYDRANTS VALVES SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

PIPE

The 100 largest cities in the United States, surveyed recently, have more than 95,000 total miles of water mains — more than 90% of which is cast iron pipe!

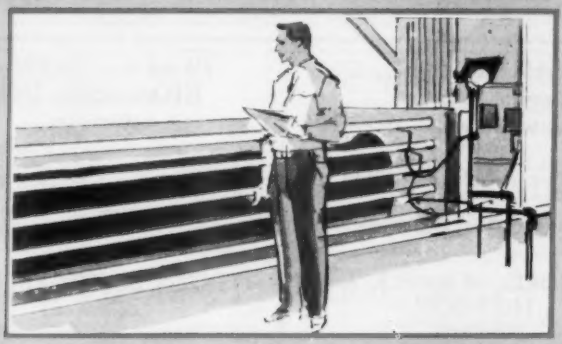


DO YOU KNOW that when larger distribution mains are needed, the smaller mains can be reclaimed for years of additional service . . . if they are cast iron? In Reading, Pa., for example . . . seven miles of cast iron pipe was taken up and relaid — saving about $350,000. Rarely, if ever, is composition pipe taken up and re-used.

DO YOU KNOW that the AMERICAN Fastite Joint requires no calking? Its only joint component is a dual hardness, easily-inserted, double-sealing rubber gasket. A minimum of labor and equipment is needed to install Fastite pipe . . . and the extra minutes saved soon total up to additional dollars saved in installation costs.

*Patent applied for

FACTS



DO YOU KNOW that cast iron pipe is designed to withstand expected water hammer shocks which can burst weaker mains? In tests, it required 3,400 psi water pressure to burst 6" Class 150 AMERICAN pipe. Composition pipe of similar size and class failed at 770 psi.

DO YOU KNOW that industry requires large volumes of water... and it must be economical? For most new industrial plants, water is the most important natural resource. In the long run, cast iron pipe delivers water cheapest of all.

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM ALABAMA

Professional Services

ALBRIGHT & FRIEL, INC.

Consulting Engineers

Water, Sewage, Industrial Wastes and Incineration Problems
City Planning, Highways, Bridges and Airports
Dams, Flood Control, Industrial Buildings
Investigations, Reports, Appraisals and Rates

Three Penn Center Plaza Philadelphia 2, Pa.

BLACK, CROW & EIDSNESS, INC.

Engineers

Water, sewerage, power, hydrology, recalcination, waste treatment, special investigations and reports, laboratory services

700 S. E. Third Street Gainesville, Florida
74 Orchid Square Boca Raton, Florida

ALVORD, BURDICK & HOWSON

Engineers

Water Works, Water Purification, Flood Relief, Sewage Disposal
Drainage, Appraisals, Power Generation

20 North Wacker Drive Chicago 6

CLINTON BOGERT ENGINEERS

Consultants

IVAN L. BOGERT — ROBERT A. LINCOLN
CHARLES A. MANGANARO — WILLIAM MARTIN

Water & Sewage Works — Incinerators
Drainage — Flood Control
Highways and Bridges — Airfields

145 East 32nd Street, New York 16, N. Y.

AWWA STANDARDS

for Water Works Materials

Compiled, approved and published by your Association to meet your needs.

Send for list of publications.

American Water Works Association, Inc.
2 Park Avenue New York 16, N.Y.

Bowe, Albertson & Associates

Engineers

Water and Sewage Works
Industrial Wastes
Refuse Disposal
Valuations
Fesibility Reports
Laboratory Service

75 West Street
New York 6, N.Y.

AYRES, LEWIS, NORRIS & MAY

Consulting Engineers

LOUIS E. AYRES — ROBERT NORRIS
GEORGE E. LEWIS — DONALD C. MAY
STUART B. MAYNARD — HOMER J. HAYWARD
JOSEPH D. CRAIGMILE — RAYMOND J. SMIT

Waterworks, Sewerage, Electric Power

500 Wolverine Building, Ann Arbor, Michigan

BROWN AND CALDWELL

Civil and Chemical Engineers

Water—Sewage—Industrial Waste
Consultation—Design—Operation
Chemical and Bacteriological Laboratories

66 Mint Street San Francisco 3

BLACK & VEATCH

Consulting Engineers

1500 Meadow Lake Parkway, Kansas City 14, Missouri

Water Supply Purification and Distribution; Electric Lighting and Power Generation, Transmission and Distribution; Sewerage and Sewage Disposal; Gas: Rates, Valuations, Investigations and Reports

BUCK, SEIFERT AND JOST

Consulting Engineers

WATER SUPPLY—SEWAGE DISPOSAL—HYDRAULIC DEVELOPMENTS

Reports, Investigations, Valuations, Rates, Design, Construction, Operation, Management, Chemical and Biological Laboratories

112 E. 19th St., New York 3, N. Y.

Professional Services

BURGESS & NIPLE

Consulting Engineers

(Established 1908)

Water Supply, treatment and distribution
Sewage and industrial wastes disposal
Investigations, reports, appraisals, rates
Laboratory Municipal engineering
Supervision

2015 W. Fifth Ave. Columbus 12, Ohio

THE CHESTER ENGINEERS

Water Supply and Purification
Sewage and Industrial Waste Treatment
Power Plants—Incineration—Gas Systems
Valuations—Rates—Management
Laboratory—City Planning

601 Suismon Street
Pittsburgh 12, Penna.

BURNS & McDONNELL

Engineers—Architects—Consultants

4600 E. 63rd St. Trafficway
Kansas City 41, Missouri

CLARK, DAILY & DIETZ

Consulting Engineers

Sewerage, Waterworks, Street Lighting, Highways, Swimming Pools, Surveying and Mapping, Land Development Studies, Bridges, Buildings, Foundations

211 N. Race St. Urbana, Illinois
188 Jefferson St. Memphis, Tennessee

JAMES M. CAIRD

Established 1898

C. E. CLIFTON, H. A. BENNETT

Chemist and Bacteriologist

WATER ANALYSIS
TESTS OF FILTER PLANTS

Cannon Bldg. Troy, N. Y.

CHAS. W. COLE & SON

Engineers and Architects

3600 E. Jefferson Blvd. South Bend, Indiana
2112 W. Jefferson St. Joliet, Illinois

CAMP, DRESSER & McKEE

Consulting Engineers

Water Works, Water Treatment, Sewerage and Wastes Disposal, Flood Control

Investigations, Reports, Design Supervision, Research, Development

18 Tremont St. Boston 8, Mass.

CONSOER, TOWNSEND & ASSOCIATES

Consulting Engineers

Sewage treatment, sewers, storm drainage, flood control — Water supply and treatment — Highway and bridges—Airports—Urban renewal—Electric and gas transmisson lines — Rate studies, surveys and valuations — Industrial and institutional buildings.

360 East Grand Avenue Chicago 11, Illinois

CAPITOL ENGINEERING CORPORATION

Consulting Civil Engineers

Dillsburg, Pennsylvania, U.S.A.

DAY & ZIMMERMANN, INC.

Consulting Engineers

Valuations
Feasibility Studies & Reports
Rate Cases & Financial Studies
Supervisory Consulting Service

1700 Sansom St. Philadelphia 3, Pa.

Professional Services

GIBBS & HILL, INC.

Consulting Engineers

Water Supply and Treatment
Industrial and Municipal Waste Treatment
Electric Power and Transmission
Transportation and Communication

Pennsylvania Station New York 1, New York

Fay, Spofford & Thorndike, Inc.

Engineers

Water Supply and Distribution — Drainage
Sewerage and Sewage Treatment—Incinerators
Airports — Bridges — Express Highways

Investigations Reports Valuations
Designs Supervision of Construction

11 Beacon St., Boston 8, Massachusetts

GREELEY AND HANSEN

Engineers

Water Supply, Water Purification
Sewerage, Sewage Treatment
Refuse Disposal

14 E. Jackson Blvd., Chicago 4

FINKBEINER, PETTIS & STROUT

Consulting Engineers

Water Supply, Water Treatment,
Sewerage, Sewage Treatment,
Bridges, Highways & Expressways

2130 Madison Avenue Toledo 2, Ohio

WILLIAM F. GUYTON & ASSOCIATES

Consulting Ground-Water Hydrologists

Underground Water Supplies
Investigations, Reports, Advice

307 W. 12th St.
Austin 1, Texas
Phone: GR-7-7165

FROMHERZ ENGINEERS

Structural—Civil—Municipal

Four Generations Since 1867

Water Supply; Sewerage; Structures;
Drainage; Foundations
Highways & Streets
Investigations; Reports; Plans and
Specifications; Supervision

New Orleans

HASKINS, SHARP & ORDELHEIDE

Consulting Engineers

Water—Sewage & Industrial Wastes—
Hydraulics
Reports, Design, Supervision of Construction,
Appraisals, Valuations, Rate Studies

1009 Baltimore Avenue Kansas City 5, Mo.

GANNETT FLEMING CORDDRY & CARPENTER, Inc.

Engineers

Water Works—Sewerage
Industrial Wastes—Garbage Disposal
Roads—Airports—Bridges—Flood Control
Town Planning—Appraisals
Investigations & Reports

Harrisburg, Pa. Philadelphia, Pa.
Pittsburgh, Pa. Daytona Beach, Fla.

HAVENS & EMERSON

A. A. Burger A. M. Mock
J. W. Avery F. S. Palocsay
E. S. Ordway G. H. Applanalp
S. H. Sutton
F. C. Tolles, Consultant

Consulting Engineers

Water, Sewage, Garbage, Industrial
Wastes, Valuations—Laboratories

Leader Bldg. Woolworth Bldg.
CLEVELAND 14 NEW YORK 7

GEOLOGICAL SERVICE ASSOCIATES

Engineering and Ground Water Geology

Capacity Tests, Investigations, Resistivity
and Seismic Surveys, Reports, Well and Well
Field Design, Water Chemistry, and Supervision

1014 Havey Road CHerry 9-1492
Madison 4, Wisconsin

HAZEN AND SAWYER

Engineers

Richard Hazen Alfred W. Sawyer
H. E. Hudson, Jr.

Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control

360 Lexington Ave. New York 17, N.Y.

Professional Services

ANGUS D. HENDERSON
Consulting Engineers
ANGUS D. HENDERSON THOMAS J. CASEY

Water Supply and Sanitation

330 Winthrop St. Westbury, New York
210-07—29th Ave. Bayside, New York

JONES, HENRY & WILLIAMS
Consulting Sanitary Engineers

Water Works
Sewerage & Treatment
Waste Disposal

2000 West Central Avenue Toledo 6, Ohio

H. G. Holzmacher & Associates
Consulting Engineers
H. G. HOLZMACHER
R. G. HOLZMACHER S. C. McLENDON

Municipal Engineering
Water Supply & Treatment
Sewerage & Treatment
Water Analysis Laboratory

500 Broad Hollow Road, Melville, New York
66 W. Marie Street, Hicksville, New York

W. G. KECK & ASSOCIATES, INC.
Consultants in Geophysics

Ground water specialists—serving consulting engineers, municipalities, and industry

Aquifer evaluation—Resistivity surveys
Seismic surveys—Well logging
Geological studies

P.O. BOX 107 ED 7-1420
EAST LANSING, MICHIGAN

HORNER & SHIFRIN
Consulting Engineers
E. E. Bloss V. C. Lischer

Airports, Sewerage & Drainage, Hydrology, Sewage & Industrial Waste Treatment, Water Supply & Treatment, Paving, Structures, Industry Engineering Services

1221 Locust Street St. Louis 3, Mo.

HARRY J. KEELING
Consulting Engineer
Electrical—Mechanical—Corrosion

Investigations—Reports—Advisory Service
Mobile radio communication systems;
Special mechanical design problems;
Soil corrosion, Electrolysis,
Cathodic protection
of buried or submerged metal surfaces.

1780 S. Robertson Blvd. Los Angeles 35, Calif

ROBERT W. HUNT CO.
Inspection Engineers
(Established 1888)

Inspection and Test at Point of Origin of Pumps, Tanks, Conduit, Pipe and Accessories

810 S. Clinton St.
Chicago 7, Ill.
and Principal Mfg. Centers

KENNEDY ENGINEERS
RICHARD R. KENNEDY ROBERT M. KENNEDY

Investigation—Design
Water Supply Water Purification
Sewage and Waste Treatment
Water Reclamation

604 Mission St., San Francisco 5
Tacoma Los Angeles Salt Lake City

THE JENNINGS-LAWRENCE CO.
Civil & Municipal Engineers
Consultants

Water Supply, Treatment & Distribution
Sewers & Sewage Treatment
Reports—Design—Construction

1392 King Avenue Columbus 12, Ohio

DEAN S. KINGMAN
Consulting Engineer

Water Works
Sewerage & Treatment

1907 University Avenue
Palo Alto, California

Professional Services

KIRKHAM, MICHAEL & ASSOCIATES

Engineers - Architects

Complete Municipal & Industrial Services: Investigations, Reports, Design, Supervision of Construction, Rates

WATER—SEWAGE & WASTES—STREETS
AIRPORTS—BRIDGES & STRUCTURES

Omaha, Neb. — 508 South 19th St.
Rapid City, S. D. — 519 Kansas City St.
Fargo, N. D. — 802 Sixth Avenue North

METCALF & EDDY

Engineers

Investigations · Reports
Planning · Siting · Design
Supervision of Construction & Operation
Valuations · Rates · Research · Management

1300 Statler Building, Boston, Massachusetts

MORRIS KNOWLES INC.

Engineers

Water Supply and Purification,
Sewerage and Sewage Disposal,
Industrial Wastes, Valuations,
Laboratory, City Planning

Park Building — Pittsburgh 22, Pa.

JAMES M. MONTGOMERY

Consulting Engineers, Inc.

Water Supply—Water Purification
Sewerage—Sewage and Waste Treatment
Flood Control—Drainage
Valuations—Rates
Investigations—Design—Operation

535 E. Walnut St. — Pasadena, Calif.

KOEBIG & KOEBIG

Consulting Engineers Since 1910

Investigations, Reports, Designs
Water Supply & Water Treatment
Sewerage & Sewage Treatment
Municipal Engineering

3242 W. Eighth St. — Los Angeles 5, Calif.

Nussbaumer, Clarke & Velzy, Inc.

Consulting Engineers

Sewage Treatment—Water Supply
Incineration—Drainage
Industrial Waste Treatment
Appraisals

327 Franklin St., Buffalo, N. Y.
500 Fifth Ave., New York 36, N. Y.

LEGGETTE, BRASHEARS & GRAHAM

Consulting Ground Water Geologists

Water Supply — Salt Water Problems
Dewatering — Investigations
Recharging — Reports

551 Fifth Avenue — New York 17, N. Y.

PARSONS, BRINCKERHOFF, QUADE & DOUGLAS

Civil and Sanitary Engineers

Water, Sewage, Drainage and
Industrial Waste Problems.

Structures — Power — Transportation

165 Broadway — New York 6, N. Y.

ARTHUR T. LUCE

Consulting Engineer

Water Works—Sewerage
Investigations, Reports, Plans and
Specifications, Appraisals, Rate Studies,
Supervisory Consulting Service

306 Plainfield Road — Metuchen, N.J.

MALCOLM PIRNIE ENGINEERS

Malcolm Pirnie — Carl A. Arenander
Ernest W. Whitlock — Malcolm Pirnie, Jr.
Robert D. Mitchell — Alfred C. Leonard

Municipal and Industrial
Water Supply—Water Treatment
Sewage and Waste Treatment
Drainage—Rates—Refuse Disposal

25 W. 43rd St., New York 36, N.Y.
3013 Horatio St., Tampa 9, Fla.

THE PITOMETER ASSOCIATES, INC.

Engineers

Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement & Special Hydraulic Investigations

50 Church Street — New York

Professional Services

Professional Cards in the JOURNAL AWWA

A must for water supply consultants

Reserve your space now

American Water Works Association, Inc.
2 Park Avenue — New York 16, N.Y.

ROBERT AND COMPANY ASSOCIATES

MUNICIPAL ENGINEERING DIVISION
ATLANTA

Power Plants • Water Sewage Plants
Airports • Industrial Plants • Investigations
Docks and Terminal Facilities • Reports

LEE T. PURCELL

Consulting Engineer

Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Investigations & Reports; Design; Supervision of Construction & Operation

Analytical Laboratories

36 De Grasse St. — Paterson 1, N. J.

RUSSELL & AXON

Consulting Engineers

Civil—Sanitary—Structural
Industrial—Electrical
Rate Investigations

408 Olive St., St. Louis 2, Mo.
Municipal Airport, Daytona Beach, Fla.

RADER AND ASSOCIATES

Engineers and Architects

Water Supply, Treatment and Distribution
Sewers and Sewage Treatment
Investigations, Reports, Plans
Supervision of Construction and Operations
Aerial Photography, Photogrammetry

The First National Bank Building, Miami 32, Florida
1025 Connecticut Ave. N. W. Washington 6, D. C.

SERVIS, VAN DOREN & HAZARD

Engineers—Architects

INVESTIGATIONS · DESIGN · SUPERVISION OF CONSTRUCTION · APPRAISALS

Water · Sewage · Streets · Expressways · Highways · Bridges · Foundations · Airports · Flood Control · Drainage · Aerial Surveys · Site Planning · Urban Subdivisions · Industrial Facilities
Electrical · Mechanical

2910 Topeka Blvd. — Topeka, Kansas

THOMAS M. RIDDICK & ASSOCIATES

Consulting Engineers and Chemists

Municipal and Industrial Water Purification, Sewage Treatment, Plant Supervision, Industrial Waste Treatment, Laboratories for Chemical and Bacteriological Analyses

369 E. 149th St. — New York 55, N.Y.
MOtt Haven 5-2424

J. E. SIRRINE COMPANY

Engineers Since 1902

GREENVILLE, SOUTH CAROLINA

Design, Reports, Consultations
Water Supply and Treatment
Sewage and Industrial Waste Treatment
Stream Pollution Surveys
Chemical and Bacteriological Analyses

RIPPLE & HOWE, INC.

Consulting Engineers

V. A. VASEEN — B. V. HOWE

Appraisals—Reports
Design—Supervision

Water Works Systems, Filtration and Softening Plants, Reservoirs, and Dams, Sanitary and Storm Sewers, Sewage Treatment Plants, Refuse Disposal, Airports

2747 Zuni St., Denver 11, Colo.

SMITH AND GILLESPIE

Consulting Engineers

MUNICIPAL UTILITIES
AND PUBLIC WORKS

Complete Engineering Services

JACKSONVILLE, FLORIDA

STANLEY ENGINEERING COMPANY

Consulting Engineers

Hershey Building, Muscatine, Ia. — 208 S. LaSalle St., Chicago 4, Ill.

Hanna Building, Cleveland 15, Ohio

ROY F. WESTON, INC.

Engineers—Biologists—Chemists

Water—Sewage—Industrial Wastes—Refuse
Stream pollution—Air pollution—Industrial Hygiene

Surveys—Research—Development—Process Engineering—Plans and Specifications—Operation Supervision—Analyses—Evaluations and Reports

Newtown Square, Pa.

ALDEN E. STILSON & ASSOCIATES

(Limited)

Consulting Engineers

Water Supply—Sewerage—Waste Disposal
Bridges—Highways—Industrial Buildings
Studies—Surveys—Reports

245 N. High St., Columbus, Ohio — 75 Public Square, Cleveland 13, Ohio

WESTON & SAMPSON

Consulting Engineers

Water Supply and Purification; Sewerage, Sewage and Industrial Wastes Treatment. Reports, Designs, Supervision of Construction and Operation; Valuations.
Chemical and Bacteriological Analyses

14 Beacon Street, Boston 8, Mass.

WARD AND MOORE

Consulting Engineers

Civil, Municipal, Structural, Land Planning

Water Supply, Sewage Disposal, Drainage, Streets, Parks, Subdivisions, Buildings and Structures

Investigations, Reports, Design, Supervision of Construction

P.O. Box 178, Corning, N.Y.

WHITMAN & HOWARD

Engineers

(Est. 1869)

Investigations, Designs, Estimates, Reports, Supervision, Valuations, etc., in all Water Works and Sewerage Problems

89 Broad St., Boston, Mass.

WATER SERVICE LABORATORIES, INC.

Specialists in Water Treatment
Consulting and Technical Services

Main Office: 615 W. 131 St., N. Y. 27, N. Y.
Offices also in: Phila., Wash., & Richmond

WHITMAN, REQUARDT & ASSOCIATES

Engineers *Consultants*

Civil—Sanitary—Structural
Mechanical—Electrical
Reports, Plans
Supervision, Appraisals

1304 St. Paul St., Baltimore 2, Md.

J. STEPHEN WATKINS

J. S. Watkins — G. R. Watkins

Consulting Engineers

Municipal and Industrial Engineering, Water Supply and Purification, Sewerage and Sewage Treatment, Highways and Structures, Reports, Investigations and Rate Structures.

446 East High Street, Lexington, Kentucky

Branch Offices
2617 Dixie Highway, Louisville 16, Kentucky
107 Hale Street, Charleston, W. Va.

WIEDEMAN and SINGLETON

Engineers

Water Supply,
Sewerage,
Sewage and
Waste Disposal

760 West Peachtree Street, N.W.
Atlanta 8, Georgia

R. KENNETH WEEKS

ENGINEERS

Designers • *Consultants*

Water Supply and Purification
Sewerage and Sewage Treatment
Investigations and Reports
Supervision of Construction

Streets and Highways

6165 E. Sewells Point Road, Norfolk 13, Va.

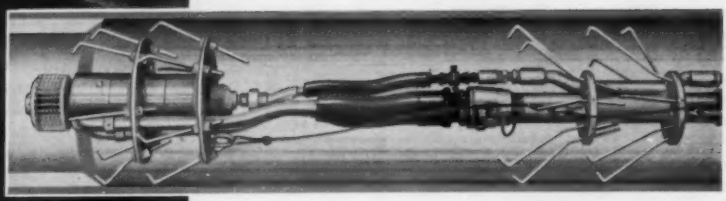
WILSEY, HAM & BLAIR

Engineers and Planners

Investigation and Design
Water Supply, Treatment and Distribution
Utilities Rate and Valuation Studies
Sewage Treatment and Disposal
Airports, Municipal Works and City Planning

111 Rollins Road, Millbrae, California — 800 W. Colorado Blvd., Los Angeles 41, Calif.

A TOOL FOR STOPPING CORROSION



SPUNLINE®
saves pipelines

DOUGLAS AIRCRAFT RESTORES 14,000 FEET

Mechanical cleaning and Spunline rehabilitation have saved Douglas Aircraft Company the trouble and expense of replacing 14,000 feet of heavily corroded water pipelines at its El Segundo, California plant.

The Spunline process permanently cures internal corrosion of pipelines. It restores pitted, leaky, inefficient water lines to their original capacity, seals every leak and *stops corrosive action.*

In preparation for Spunline rehabilitation, our expert crews clean pipeline interiors of all corrosion, tubercles and other foreign matter. Then special Spunline equipment applies a continuous lining of dense cement mortar to the pipe interior. The process may be used to rehabilitate cast iron, steel, wrought iron or concrete pipelines from 4 to 180 inches in diameter. All work is done in place without interrupting normal traffic.

Send for bulletin with detailed data and specifications.

PIPE LININGS Inc.

OUR TWENTIETH YEAR 20TH PIPE LININGS, INC.

Subsidiary of American Pipe and Construction Co.

2414 East 223rd Street, Wilmington, California
P.O. Box 457 • Phones: SPruce 5-3273 · TErminal 5-8201
50 Church Street, New York 7, N.Y. • P.O. Box 1202, Fort Worth, Texas

SPUNLINE®

Condensation

Key: In the reference to the publication in which the abstracted article appears, 39:473 (May '47) indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, 39:5:1 (May '47) indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *BH—Bulletin of Hygiene (Great Britain); CA—Chemical Abstracts; Corr.—Corrosion; IM—Institute of Metals (Great Britain); NSA—Nuclear Science Abstracts; PHEA—Public Health Engineering Abstracts; SIW—Sewage and Industrial Wastes; WPA—Water Pollution Abstracts (Great Britain).*

TASTE AND ODOR

How Nitrates Reduced Odors in Flooded Trickling Filters. L. E. WALLER & R. S. INGOLS. *Wastes Eng.*, 31:258 ('60). A heavily overloaded South River Plant served Atlanta, Ga., until a 6-mgd standard trickling filter plant was rebuilt to treat 13 mgd. At present, control of filter flies is accomplished by flooding each filter (4, in all) on a weekly cycle. While the filters are flooded, the organic wastes from 3 food industries, added to the domestic sewage, produce an anaerobic condition in the bed, with consequent hydrogen sulfide release to the air. By application of chlorine and orthodichlorobenzene during the flooding of the filters, at a cost of approximately $100 per day, the odor of hydrogen sulfide was controlled. As a substitute, sodium nitrate soln. was added to the raw sewage to insure sufficient available oxygen to prevent sulfate reduction to sulfides. This method of application failed, and the addn. of sodium nitrate directly to the filter during the flooding operation was tried. A 100-lb sack of sodium nitrate is added to 1,000 gal of water; 1,000 lb of sodium nitrate are required per bed in summer, and 500 lb per bed in cooler weather, at a cost of $30 and $15, respectively, per bed. Insecticides were also tried to control the fly nuisance; this was effective, but the cost was $45 per bed, plus labor. The nitrate method of control is used routinely; a reduction in BOD is a bonus when this material is used to control anaerobic conditions.—*PHEA*

Detrimental Odors and Tastes of Drinking Water—Causes and Remedies. J. HOLLUTA. *Gas- u. Wasserfach* (Munich), 101:1018, 1070 ('60). The poln. of water supplies, esp. surface water, with substances causing detrimental odors and tastes is a problem for the entire world. The literature is reviewed as to causes and nature of these contamg. materials. There are no existing phys. methods for measuring the strength and intensity of these effects. An ext. of these materials can be obtained with activated C, and chromatographic columns can be used for their sepn. and identification. Data are given for exts. of these materials from the Rhine and its tributaries, obtained by adsorption on activated C followed by extn. of the activated C with org. solvents. Data are given for amt. of ext. and T.O. value (min. amt. at which odor can be detected in odorfree water). These tests indicated that the T.O. value was always less from bank-filtered well water than from river water near the bank. However, the T.O. value for the bank-filtered water rose with that of the river water; this rise was the sharpest in a dry year. Without considering cost data, best results are secured for odor and taste removal under these conditions by treating with a combination of Wolfatit E and activated C, rather than with activated C alone. Wolfatit E has only a limited capac. for phenol removal.—*CA*

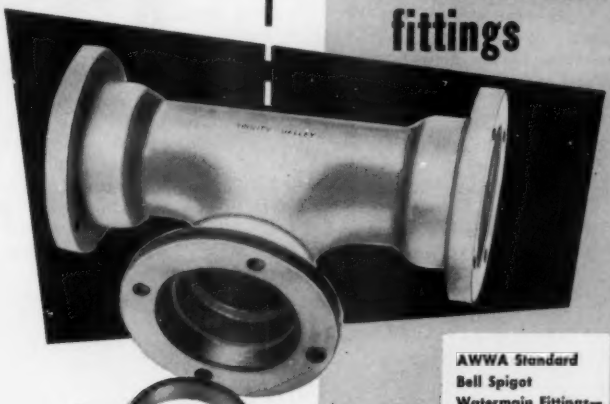
Tastes and Odors Due to Hydrocarbons. G. VAN BENEDEN. *Bul. mens. Cebedeau*, No. 111, 95 ('60). The general picture of taste and odor due to hydrocarbon pollutants is considered, including causes of tastes and odors, their perception, the estn. of their intensity, and their classification. Indexes and effect of such poln. are discussed. Toxicity due to hydrocarbons are considered under paraffines, ethylene, and acetylene materials present. Several methods of treatment for specific chems. are suggested, but it is admitted that no completely effective treatment is yet known.—*PHEA*

Control of Drinking Water Taste and Odor. C. SIKOROWSKA. *Gaz, Woda i Tech. Sanitarna*, 34:246 ('60). A review of methods to control taste and odor in drinking water, including an extensive list of references, is given.—*CA*

(Continued on page 74 P&R)

TRINITY VALLEY

for all cast iron water works fittings



AWWA Standard Bell Spigot Watermain Fittings—2" through 36".

Ring Tite Fittings 3" through 20" Class 150. Class 100 through 12".

Short Body and Mechanical Joint Watermain Fittings—2" through 20".

Fluid-Tite Fittings—3" through 16" Class 150. Class 100 through 12".

Fabricated Piping

Flange Fittings

TRINITY VALLEY IRON AND STEEL COMPANY

Phone PE 8-1925 Fort Worth, Texas P. O. Box 2388

(Continued from page 72 P&R)

Taste and Odor Control in the US With Specific Reference to the Southwestern Area. E. SIGWORTH. *Southwest Wtr. Wks. J.*, 41:20 ('60). In the southwestern area, activated C had an overall effectiveness of 86%, ClO_2 25%, super- and dechlorination 23%, free-residual chlorination 17%, and aeration 9%.—*CA*

Taste and Odor Causes in Water. M. B. ETTINGER. *Munic. Utilities Mag.*, 96:27, 50 ('58). In a paper presented at the 1957 Ontario Industrial Waste Conference, the author discussed the causes and characteristics of tastes and odors in water, especially the chem. impairment of water qual. for munic. or industrial use. The effects that chlorine has on tastes and odors are described, and the problems encountered when detg. odor strength are discussed.—*PHEA*

Removal of Materials Causing Odor and Taste From Drinking Water With Active Charcoal. M. SIMON & W. BUTGEREIT. *Gas- u. Wasserfach* (Munich), 101:337 ('60). Large-scale expts. for the removal of odor and taste from bank-filtered H_2O (part of the Duisberg H_2O supply) are described. The 8 C filters have a total capac. of 1,600 cu m/hr. Active C loss is 7–8 g/cu m of H_2O treated. Cost data are given for German conditions—the cost of once-regenerated (heating in absence of air) C is about half that of fresh C. The water is chlorinated, aerated (owing to low O cont.), and then passed through a Mn sand filter. After passing through the C filter, ClO_2 is added to remove the Cl taste.—*CA*

Tastes and Odors in Water. M. ETTINGER & A. A. ROSEN. *Ind. Wastes*, 3:85 ('58). The problems caused by tastes and odors in water are discussed, with special reference to the impairment of qual. for munic. and industrial use. Concn. of the odorous org. pollutants in drinking water showed that the most abundant were neutral substances, followed by org. acids. Other substances present included org. bases, water-soluble compounds, and weakly acidic compounds,

(Continued on page 78 P&R)

Magnified activated silica sol floc.

*Patent No. 2,567,285, license royalty free

N-Sol is prepared with N Silicate and a reacting chemical in your plant.

WANT
CLARIFICATION RESULTS LIKE THESE?
...try Activated Silica Sol

- Reduced alum consumption saves $30.00 per day
- Filter runs extended 50%, to about 36 hours
- Best water we have ever seen

This report comes from a water company treating 30 million gallons daily. Activated silica sol was needed to solve cold water coagulating problems. Advantages prompted year-round application where they rely on "N" silicate (only ½ ppm SiO_2) fed continuously by way of the N-Sol-C Process.*

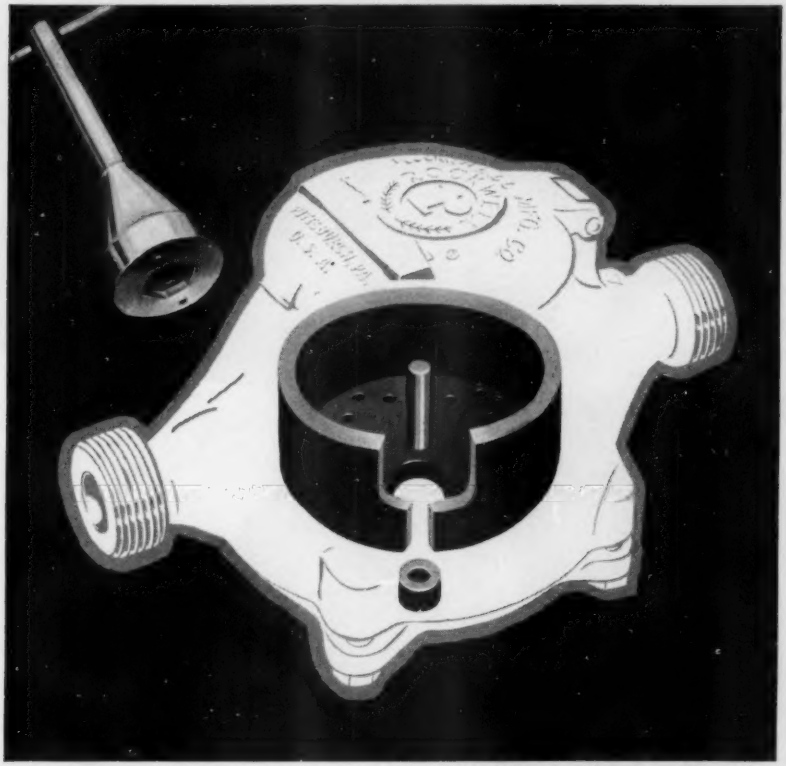
Send for Bulletin, "Treatment Of Raw And Waste Waters."

PQ
130TH ANNIVERSARY 1831-1961

PHILADELPHIA QUARTZ COMPANY
1142 Public Ledger Building, Philadelphia 6, Pa.
manufacturers of
Trademarks Reg. U.S. Pat. Off.
SOLUBLE SILICATES

Associates: Philadelphia Quartz Co. of Calif. Berkeley & Los Angeles, Calif.; Tacoma, Wash.; National Silicates Limited, Toronto & Valleyfield, Canada

PQ Plants: Anderson, Ind.; Baltimore, Md.; Buffalo, N.Y.; Chester, Pa.; Jeffersonville, Ind.; Kansas City, Kan.; Rahway, N.J.; St. Louis, Mo.; Utica, Ill.



Only 2 Working Parts and a Wrench

YOU ASKED FOR IT!

Early in the development of our Sealed Register* "magnetic" meter, one thing became apparent. *This design would practically put us out of the parts business.*

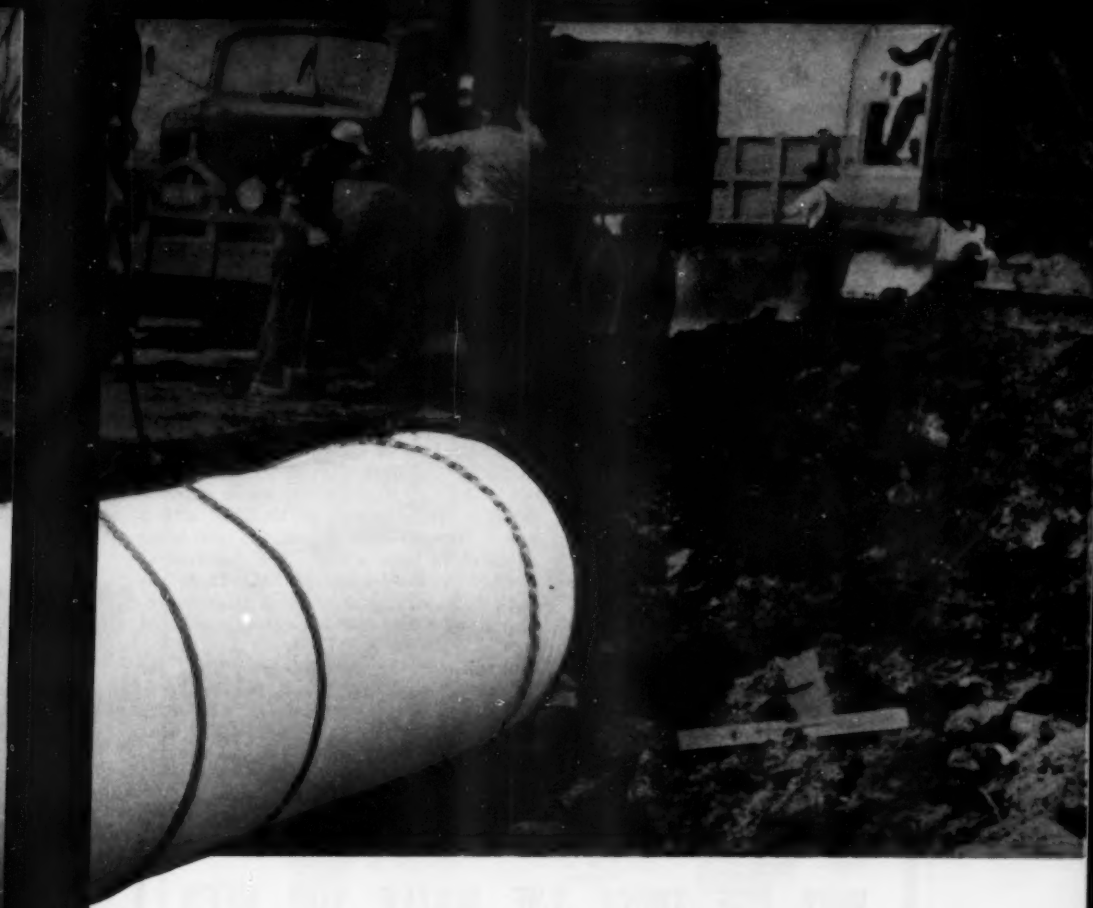
But we went ahead because our surveys showed you wanted a meter with fewer parts and one that would be easier and more economical to repair.

Now you can benefit from a *two part inventory.* A wrench is the only tool required. Let our representative prove this to you or write for bulletin W-811. Rockwell Manufacturing Company, Dept. 163K, Pittsburgh 8, Pa. In Canada, Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

**Trademark*

Imitated but never equalled

SEALED REGISTER* METERS
another fine product by
ROCKWELL



FORCE MAINS...
critical link in sewer systems

The collection and treatment of sewage often requires pumping through force mains in various parts of the system. No other method of piping for force mains offers the many advantages provided by Concrete Pressure Pipe.

Dense, impervious . . . smooth of interior . . . Concrete Pressure Pipe has excellent hydraulic properties. This means low pumping costs that stay low over the long life of the installation. Little or no maintenance is required. Pipe joints are formed to close tolerances, sealed with watertight yet flexible rubber gaskets, and are easily assembled. Concrete Pressure Pipe can be designed for a wide combination of external loads and internal pressures.

If your city is one of the many requiring sewer system expansion, investigate Concrete Pressure Pipe. It will save you money now and for years to come.

WATER FOR GENERATIONS TO COME

Concrete
PRESSURE
Pipe

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street • Chicago 1, Illinois

(Continued from page 74 P&R)

such as phenol derivatives which occur infrequently and have little taste and odor unless chlorinated. The presence of free-residual chlorine destroys the odor of chlorinated phenols. The odor characteristics of surface waters often vary seasonally. With pollutants subject to biologic destruction, the odor intensity tends to reach a peak in the winter, as a result of scouring of bottom deposits and more rapid transport of dissolved material, and, if the river freezes, of anaerobic conditions. With pollutants resistant to biologic destruction, maximum odor may occur during any period of low flow. —*WPA*

Control of Odors and Tastes in Water Supplies. P. GUINVARC'H. *Eau*, 45:49 ('58). The discussion on tastes and odors in water at the 4th Congress of the International Water Supply Assn. is reported, as it relates to conditions in France. The following aspects are discussed: detection and measurement of tastes and odors; typical examples of odors and tastes and the methods used to remove them, with special reference to the use of ozone and chlorine dioxide; the prevention of tastes; and the control of tastes by other methods.—*WPA*

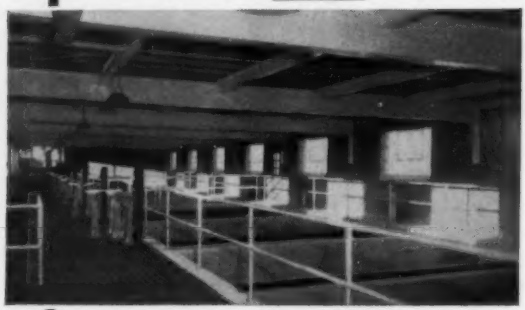
LABORATORY AND FIELD METHODS

A Rapid Routine Method for the Microdetermination of Dissolved Oxygen in Water. J. BARGH. *Chem. & Ind.* (London), 1307 ('59). A 500-ml sample of boiler feed H_2O is taken in a bottle fitted with a vacuum ground-glass stopper, the neck being extended to form a cup. The dissolved O is fixed by the Winkler method. If Fe^{++} is present in significant amts. it must be removed, by ion exchange, prior to anal.—*CA*

Continuous Oxygen Measurement for Control and Regulation of Aeration. G. STRACKE. *Gas- u. Wasserfach* (Munich), 100:293 ('59). The O concn. of effluents,

(Continued on page 80 P&R)

WHY USE TWICE THE WATER YOU NEED TO CLEAN FILTER BEDS?



H & T AIR-WATER WASH FILTERS use only half as much water as ordinary systems. Yet the air and water, together, clean the filter bed more completely!

We are the ONLY large, experienced manufacturer of Air-Water Wash Filters. In the past 45 years, we've made hundreds of successful installations. Get the money-saving facts about H & T AIR-WATER WASH FILTERS.

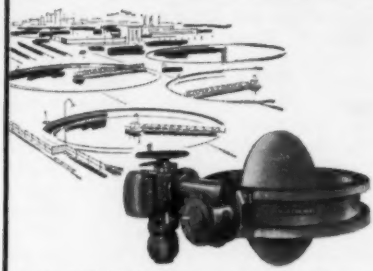
SEND FOR BULLETIN 23-B

H&T SERVICE

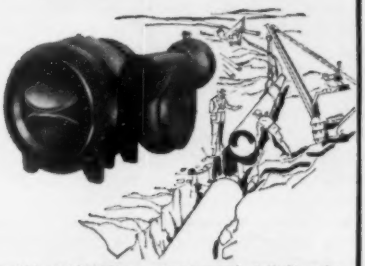
HUNGERFORD & TERRY, INC.

Clayton 5, New Jersey

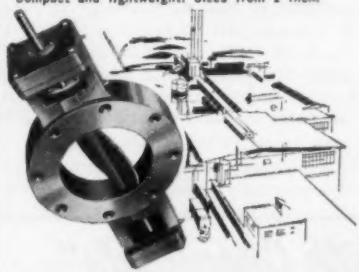
ALLIS-CHALMERS



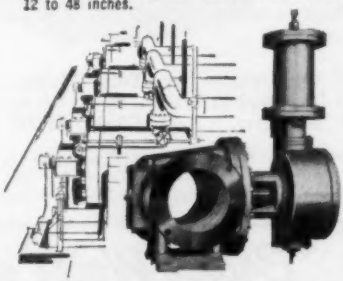
BUTTERFLY VALVES — For liquids or gases — uniform control in all positions, fast positive regulation and closure, minimum pressure drop. Compact and lightweight. Sizes from 1 inch.



BALL VALVES — Easy manual shutoff under adverse conditions, and up to 150 psi. Slight wedging action gives unusually drop-tight closure. Sizes: 12 to 48 inches.



WAFER VALVES — A new design of butterfly valves with space-saving flexibility, suited to most any type of operation. Sizes from 3 to 36 inches, including high-pressure types.



ROTOVALVE — A cone valve suited to virtually any type of operation or location. Offers the least pressure loss, greatest initial shutoff, controlled closing time, positive seating.

Now: for power plants, sewage and water works—

a full line of rotary valves

Serving you even better through a broader line—Allis-Chalmers offers the finest in butterfly, ball and cone valves for industrial applications, power plants, sewage and water works. Also available are complete valving systems in standardized "packages" that provide *remote, telemetered control of valve operation.* These additions further round out Allis-Chalmers line that includes Angle, Needle, Relief valves, sleeve-type valves and accumulator systems. *For details, contact your Allis-Chalmers valve representative or write* **Allis-Chalmers,** *Milwaukee 1, Wisconsin.*

Rotovalve is an Allis-Chalmers trademark. A-1430

(Continued from page 78 P&R)

etc., is measured by a dipping electrode brought to a potential of about −1 v against a calomel electrode, and measuring the resulting current, which is proportional to the O concn. Todt has studied this method in detail and proposed the use of a less noble and a more noble metal to set up a galvanic cell to supply the desired emf. An app. is described in which 2 dissimilar electrodes insulated from each other are rotated on a common shaft, and kept free from deposits by friction blocks pressing against the electrodes. The water should flow by the electrodes at a min. velocity of about 1 m/sec. In most cases, the O cont. indicated by this app. on effluents will be within ±10% of the value detd. by the Winkler method, except in certain industrial effluents. This app. may be used for control of aeration in aeration basins and activated sludge clarification plants.—*CA*

Method for Determining Total Hydrocarbons Dissolved in Water. A. H. Wehe & J. J. McKetta. *Anal. Chem.*, 33:291 ('61). An app. for the detn. of dissolved hydrocarbon gases in water by a technique based on Henry's law is described.—*CA*

A Method for Determining Titanium in Natural Water. J. Korkisch. *Z. anal. Chem.* (Munich), 178:39 ('60). The method consists of 3 steps: (1) concn. of Ti and sepn. from many other elements by passing it as neg. charged ascorbate complex through the anion exchanger Dowex 1; (2) sepn. of Ti from the elements absorbed together by the ion exchanger by washing the resin with 0.1*N* H_2SO_4 contg. NaF and then eluting the Ti with H_2SO_4 contg. H_2O_2; and (3) spectrophotometric detn. of Ti in the eluate, ascorbic acid being used as a reagent.—*CA*

Complexometric Method for the Determination of Zinc in Drainage Waters. S. B. Zakhar'ina. *Khim. Volokna* (USSR), No. 6, 32 ('60). From 20 to 100 ml of the water are placed in a 250-ml erlenmeyer flask in order to have 5–10 mg of Zn. If the water is basic or acidic, it is adjusted

(Continued on page 82 P&R)

"Better Wells with Chemicals"

Packaged in 50 Pound net Lithographed Steel Pails Easy and Safe to Handle.

Developed Specifically for Chemically Treating Municipal and Industrial Wells to Increase the Flow. Proven in Thousands of Wells Over the Past Ten Years

MAKE NEW WELLS BETTER & OLD WELLS LIKE NEW with—
DRY ACID® DRY ACID® SPECIAL

Reg. U. S. Pat. Off.

COTEY CHEMICAL COMPANY

Box 1239 2301 Ave. G POrter 3-1566
Lubbock, Texas

Export Office: Box 734
Fort Worth, Texas, USA

here's what "out of sight out of mind" does to a water main

"Out of sight—out of mind" can be a mighty expensive philosophy in any water distribution system. The above unretouched photograph proves this point. It shows a badly tuberculated *eight inch* main whose *inside diameter was reduced to an average of almost 4.5 inches.* Resultant higher pumping costs with reduced pressure and carrying capacity make it costly to tolerate such conditions. That is why the savings effected in reduced pumping costs frequently pay for the *low cost* of National water main cleaning.

Since there's never a charge or obligation to inspect your mains, *call National now!*

Call in National today!

NATIONAL WATER MAIN CLEANING COMPANY

50 Church Street • New York, N. Y.

EASTERN SALES REPRESENTATIVE FOR PIPE LININGS, INC.

333 Candler Building, Atlanta 3, Georgia; 920 Grayson St., Berkeley, Calif.; 115 Peterboro St., Boston 15, Mass.; 533 Hollis Road, Charlotte, N. C.; 8 S. Dearborn St., Rm. 808, Chicago 3, Ill.; P. O. Box 385, Decatur, Ga.; 2024 Merced Ave., El Monte, Calif.; 315 N. Crescent St., Flandreau, South Dakota; 3707 Madison Ave., Kansas City, Missouri; 200 Lumber Exchange Bldg., Minneapolis 1, Minn.; 510 Standard Oil Bldg., Omaha 2, Nebraska; 2910 W. Clay Street, Richmond 21, Va.; 502 West 3rd South, Salt Lake City 10, Utah; 204 Slayton St., Signal Mountain, Tenn., 424 S. Yale Avenue, Villa Park, Illinois; 7445 Chester Avenue, Montreal, Canada; 576 Wall Street, Winnipeg, Manitoba, Canada; Apartado de Correos No. 5, Bogota, Colombia; Apartado 561, Caracas, Venezuela; P. O. Box 531, Havana, Cuba; Marquinaria, Apartado 2184, San Juan 10, Puerto Rico; Bolivar 441-A, Marafl., Lima, Peru, Radhusgaten 30, Oslo, Norway

(Continued from page 80 P&R)

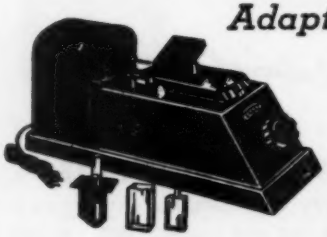
to pH = 4 (methyl orange). Ten ml of ammonium buffer is then added (35 ml of 25% NH_4OH and 5.4 g of NH_4Cl in 100 ml of water). The pH becomes 9–10. The cont. of the flask is then titrated with 0.01*N* soln. of Trilon B in the presence of Acid Chrome Dark Blue. An identical sample is placed in another flask, 1 ml of 3% soln. of NaS_2 is added, the soln. is neutralized to methyl orange, 10 ml of ammonium buffer is added, and the soln. is titrated with 0.01*N* Trilon B as before. Trilon B is standardized with a known soln. of a Zn salt. The tot. amt. of Zn present is checked by the dithizone method.—*CA*

Process for the Determination of Iodine in Natural Water. J. N. Beljajeva. *Chem. Zentr.* (Berlin), 129:1668 ('58). A sample of water, containing 1 μg or more iodine, is treated with some drops of potash soln. (0.1*N*) to give a rose color (according to the drop test with phenolphthalein) and evapd. to 20–25 ml. Of this, 20 ml are distilled for 15–20 min with 10 ml of potassium chromate and 10 ml of sulfuric acid (1:1). For reduction of iodates formed or contained in the water, about 20 ml of a saturated soln. of oxalic acid are added until a blue color forms; this is followed by boiling for 20–25 min. Iodine is detd. iodometrically or colorimetrically in the distillate, which is collected in a mixt. of 1 ml of 0.1*N* sodium sulfite and 1 ml of 0.1*N* potash soln.—*WPA*

Modified Micromethod for Determination of Organic Carbon in Natural Waters, by Combustion With Molten Potassium Nitrate. A. D. Semenov & V. G. Datsko. *Gidrokhim. Materialy* (USSR), 29:238 ('59). An improved modification of a previous method consists in a better absorption of N oxides by adding 2 supplementary absorbers: (1) with 1% $K_2Cr_2O_7$ or $Na_2Cr_2O_7$ soln. in concd. H_2SO_4; (2) with concd. H_2SO_4. The precision of detn. is raised by the use of more dil. solns. of $Ba(OH)_2$ and

(Continued on page 84 P&R)

KLETT SUMMERSON
ELECTRIC PHOTOMETER



Adaptable for Use in Water Analysis

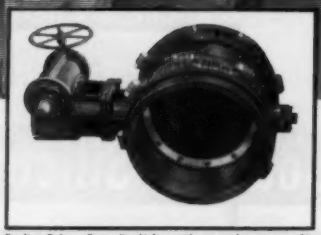
Can be used for any determination in which color or turbidity can be developed in proportion to substance to be determined

KLETT MANUFACTURING CO.
179 EAST 87th STREET · NEW YORK, N. Y.

Consulting Engineer: Finkbeiner, Pettis & Strout Contractor: Marcellette & Son Construction

Six 42" Darling-Pelton Iron Body Butterfly Valves are used on Oregon, Ohio's main water trunk line. Low operating costs, lasting safety and efficiency are essential "by-products" of this installation. Bodies, discs, and stainless steel shafts of these valves are all of sturdy construction. Discs are contoured to give minimum resistance to flow while providing necessary rigidity for maximum torque conditions. Manual operators—weatherproof and lifetime lubricated—are built to AWWA Specifications.

Darling-Pelton Butterfly Valves have a continuous 360° rubber sealing ring for drop-tight shutoff. The disc lifts away from the rubber valve seat on opening to eliminate abrasion and distortion. Darling also makes butterfly valves that can be installed with concrete pipe without the use of special fittings.



Darling-Pelton Butterfly Valve with manual operator. No adaptors are necessary when converting from a manual to either a hydraulic or pneumatic cylinder operator.

Like Oregon, Ohio, *you can depend on Darling*-Pelton Butterfly Valves to provide efficient, low cost, safe control on all your lines. Write, wire or phone for information.

DARLING VALVE & MANUFACTURING COMPANY
Williamsport 23, Pa.

The Canada Valve & Hydrant Co., Ltd.
Brantford 7, Ontario, Canada

Vannes Darling-France, 23 rue du Commandant Mouchotte, St. Mandé, France

TRADE DARLING MARK

GATE • BUTTERFLY • CHECK • SPECIAL VALVES • FIRE HYDRANTS

(*Continued from page 82 P&R*)

HCl. The forms of absorbers are also changed. The anal. results obtained with this modified method are more stable, precise, and rapid.—*CA*

Methods of Softening Drinking Water Used Abroad. W. GANDENBERGER. *Gas- u. Wasserfach* (Munich), 100:84 ('59). A crit. summary is given of water-softening methods used outside of Germany, particularly in the US, with a view to possible use in Germany.—*CA*

A Method for Carbon Disulfide Waste Water Treatment. S. KOLACZKOWSKI & E. KOSTRZEWA. *Gaz, Woda i Tech. Sanit.* (Warsaw), 33:341 ('59). Aeration, 100 l/l, was used for waste waters: (1) from a CS_2 scrubber, which had before (after) this treatment CS_2 376 (0.0), H_2S 627 (0.0), O consumed 500 (38), BOD 268 (30.2), and turbidity 200 (0.0); (2) from crude CS_2 tank, CS_2 490 (0.0), H_2S 22.0 (0.0), O consumed 78 (23), BOD 22 (14), and turbidity 150 (20); and (3) from purified CS_2 tank, CS_2 790 mg/l (0.0 mg/l), O consumed 70 (16), BOD 21 mg/l (5.8 mg/l), and turbidity 5 mg/l SiO_2 (0.0 mg/l SiO_2). Time (t in min) of aeration at a rate, v, 1–4 l/min, needed for complete removal of CS_2 from a 500-mg/l soln., is given by $tv = 60$; vapors were freed from CS_2 by passing through Polish activated coal "N" of an adsorption averaging 7 g CS_2/100 g. Satd. steam was used to regenerate the coal; losses were 20% of CS_2.—*CA*

Comparison of Four Different Methods for the Determination of Dissolved Oxygen in Fish-Pond Water. Y. ITAZAWA. *Bul. Jap. Soc. Sci. Fisheries* (Tokyo), 23:27 ('57). In detg. the concn. of dissolved oxygen in water rich in phytoplankton, the Winkler method gives low values because of absorption of iodine by the plankton, while the Miller-Sabata ferrous method gives high values as a result of an indistinct titration

(*Continued on page 88 P&R*)

for Public Water Fluoridation

Sodium Silicofluoride – 99%
(Powder)

Sodium Fluoride – 98%
(Powder or Granular)

Meet AWWA specifications

White or tinted blue • Dry and free-flowing
Minimum of storage space • Available in bags and drums
Minimum of dust in handling

THE AMERICAN AGRICULTURAL CHEMICAL COMPANY
100 Church Street, New York 7, N. Y.

AA QUALITY

Protective Coating Inspection Problems?

Here's Your Answer

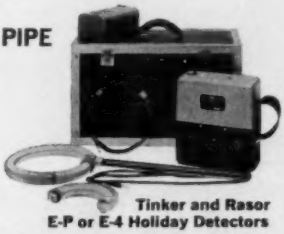
No matter whether you're coating a pipeline or a water tank, continuity is vital. Use of a Tinker and Rasor Holiday Detector while the job is open, can save days of downtime later on.

• THIN FILM

Tinker and Rasor
M-1 Holiday Detector

For painted or sprayed thin film coatings such as vinyls and epoxies. Maximum applied voltage 67½ V., non-destructive to coatings. Belt mounted, 4-lbs. total weight.

• PIPE



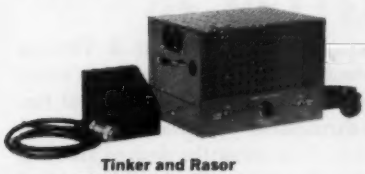
Tinker and Rasor
E-P or E-4 Holiday Detectors

Output adjustable from 5,000 to 20,000 pulsating voltage.

E-P—All purpose for larger diameter pipe, damp or dry climate, pre-fab film or hot applied coatings.

E-4—Lower cost, dry surface type of detector specifically designed for smaller diameter pipe and flat surfaces.

• PLANT AND YARDS



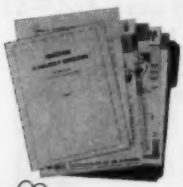
Tinker and Rasor
EPAC Holiday Detector

EPAC operates off 110 volts A.C. power for stationary coating operations. Internal voltage adjustment from 5,000 to 20,000 volts or with external variable transformer from 500 to 6,000 volts, or 5 KV to 20 KV.

• UNDERGROUND

Tinker and Rasor
Pearson-type Holiday Detector

For detecting holidays and electrical shorts without uncovering the pipeline. Completely transistorized . . . generates 15 watt, 750 cycle, stable A.C. Audio-frequency signal. Adaptable to null search method.

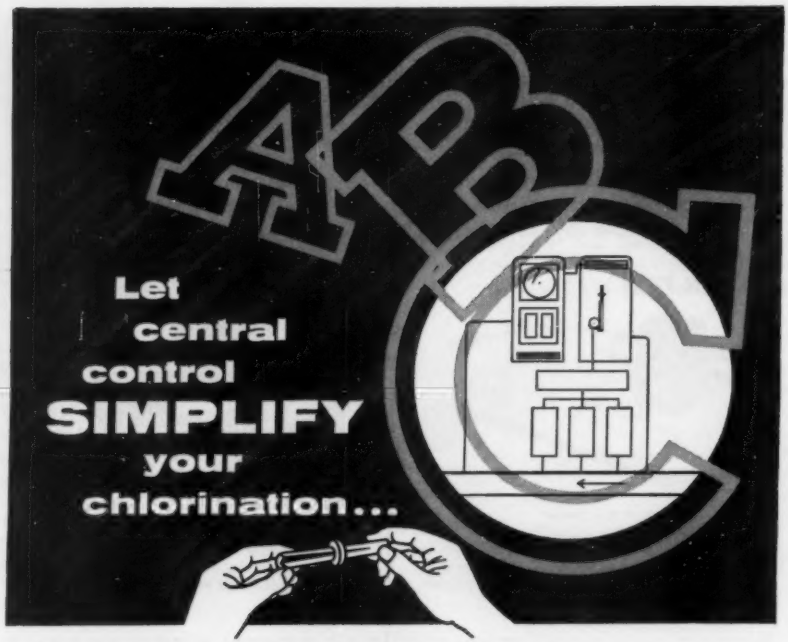


Tinker and Rasor has prepared a complete data kit which describes the null search system as well as other recommended procedures for inspecting protective coatings. Material includes technical data on equipment, general discussion of types of detectors, theory of operations, etc.

Quality Control for Coating Application

TINKER & RASOR

417 Agostino Road, P.O. Box 281 • San Gabriel, California



W&T **COMPOUND-LOOP CONTROL**

By residual analysis and information feedback, Wallace & Tiernan Compound-loop Control adjusts chlorinator feed rates to changing water flows and chlorine demands. You can add W&T Remote Residual Recording and Controlling Components throughout your water system and centralize control at any desired location. You select the desired residual on a central panel and the Compound-loop System maintains that residual faithfully.

Remote recording by W&T gives you duplicate residual records and minute-to-minute information where it helps guide operation. Remote controlling by W&T lets you adjust a chlorinator miles away. And W&T Remote Components adapt to almost any system, any type of control.

With remote residual recording and controlling by Wallace & Tiernan you centralize control... save time and operating expense... extend the advantages of the Compound-loop method.

For more information, write Dept. S-142.05

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

W&T Slaker
Saves You Hidden Water Costs

HERE'S THE SECRET OF BETTER LIME SLAKING

This torque-actuated water valve is the heart of Wallace & Tiernan's Paste-type Lime Slaker. It means easier, cleaner lime slaking . . . constant control . . . lime slaking you can do right in your plant.

Thanks to this new idea, W&T's Slaker uses less water, slakes lime completely regardless of quality or quantity, needs no pre-heating or bulky insulation. It gives you a smaller lime slaker than ever before. The 1000 lb./hr. model takes up less than 6 ft. x 2 ft.—the 8000 lb./hr. model less than 46 sq. ft.

Don't pay freight to bring water in slaked lime to your plant. Add your own water—and save—with the W&T Paste-type Lime Slaker.

For information, write Dept. M-59.05.

WALLACE & TIERNAN INC.

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

(Continued from page 84 P&R)

endpoint. Good results are obtained with the Sagawara carbon dioxide modification of the Winkler method, and with the Van Slyke method.—*WPA*

Use of a Spectrophotometric Method in Evaluating the Purity of Waters in a Water Supply Station. A. V. BOGOLYUBOVA. *Gigiena i Sanit.* (Moscow), 25:87 ('60). A spectrophotometric method in the near ultraviolet region provides control of water purification after settling, coagulation, and filtration.—*CA*

Field Determination Method of the Uranium Transfer Forms in Natural Waters. M. N. YAKOVLEVA & M. A. SHURSHALINA. *Radiokhimiya,* 1:445 ('59). To det. the form of U in natural waters, dialysis through a semipermeable cellophane membrane is proposed. Expts. were carried out without H_2O renewal, i.e., until the equil. concn. on both sides of the membrane was reached. The membrane had 20 × 20-cm surface and was carefully purified from adsorbed impurities. It was dipped into a beaker with distd. H_2O, and filled with the U-containing H_2O under investigation, with equal levels at both sides of the membrane. It was assumed that: (1) only U ions pass through the membrane; (2) natural waters have a sufficient buffer capac., insuring a const. pH value during the dialysis; (3) natural U can migrate in 3 forms: (*a*) as a mechanical suspension, (*b*) in the form of ions, and (*c*) as colloidal particles; (4) in case of *b*, the U concn. on both sides of the membrane must be equal; and (5) in case of *b* and *c* the U concn. in the bag must be higher than outside. The mechanically suspended part was detd. by filtration through a paper filter. H_2O samples contg. U were taken from 4 different geo-landscapes of the forest-steppe part of the granite-intrusion region of the European USSR. Dialysis was conducted for 2 days. It was found that in river waters at pH = 7.8, and in a well at pH = 6.7 (containing some org. matter), U is present to 100% and 92.7%, resp., in the form of

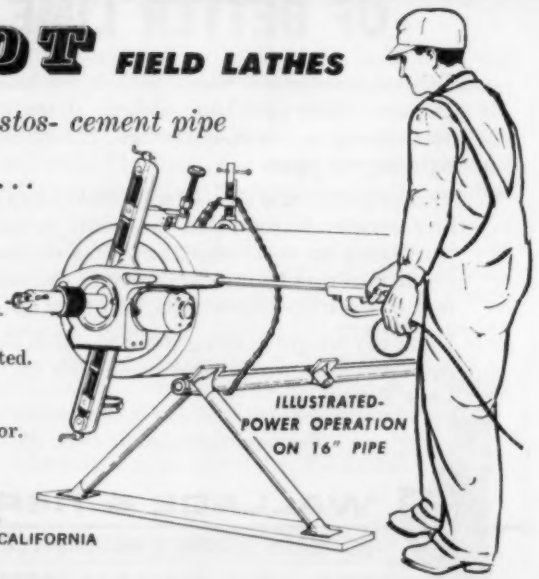
(Continued on page 90 P&R)

PILOT FIELD LATHES

machine asbestos- cement pipe

right on the job . . .

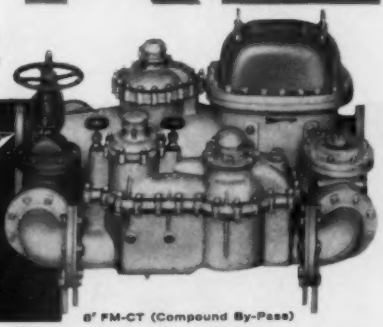
Make factory-like ends
on any length when
and where you need them.
No waiting — no delay.
Power or manually operated.
All sizes to 4" thru 20"
Write for details and
name of nearest distributor.



MANUFACTURED BY
PILOT MANUFACTURING CO.
20433 EARL ST., TORRANCE, CALIFORNIA
TELEPHONE: FRontier 6-0485

MORE
FIRE PROTECTION
MORE
REVENUE

HERSEY
DETECTOR
WATER METERS
MODEL FM (FIRE SERVICE)



6" FM-CT (Compound By-Pass)

This meter accurately measures both small and large rates of flow as required in ordinary services. In addition, it will deliver, in an emergency, the full capacity of the supply pipe with minimum loss of head. It is specially designed for use in fire or automatic sprinkler lines . . . general plant service lines . . . master metering of connecting systems . . . and other applications where wide range of flows require accurate measurement with minimum head loss. Write for literature.

MODEL FM-CT (Compound)
Bronze By-Pass Meter
Sizes 4", 6", 8", 10", 10 x 12"
Also available with Disc By-Pass Meter.

Sizes 6", 8" and 10" of Model FM-CT with compound by-pass and sizes 3" through 10" with Disc by-pass are listed as standard under the Re-examination Service of Underwriter's Laboratories, Inc., and approved by Factory Mutual Laboratories for use in Factory Mutual insured properties, also listed by Underwriter's Laboratories of Canada.

Hersey-Sparling
Meter Company
HERSEY PRODUCTS
DEDHAM, MASSACHUSETTS

Branches: Atlanta, Boston, Chicago, Cleveland, Dallas, Denver, Kansas City, Mo., Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle.

(Continued from page 88 P&R)

ions. In clear underground waters, it was partly in the ionic and partly in the colloidal form. The dialysis process itself was found to be connected with the U-ion hydrolysis. —*CA*

A Systematic Scheme of Semi-Micro Qualitative Analysis for Anionic Surface-Active Agents: An Addendum. H. Holness & W. R. Stone. *Analyst*, 84:392 ('59). In an addendum to a paper outlining a systematic scheme of semi-micro qualitative analysis for anionic surface-active agents, the authors describe the 9th in a series of tests used in their analytical system, for which 8 tests have already been given. This test involves the hydrolysis of the surface-active material with phosphoric acid. Details of procedure are given.—*WPA*

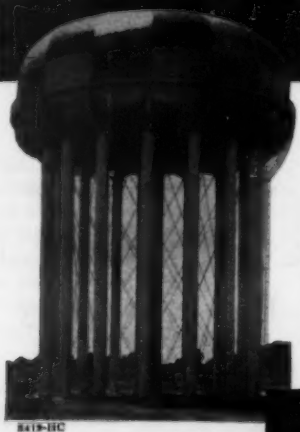
Field Methods for Determining Alkalinity, Hardness, and Calcium, Magnesium, and Chloride Contents of Water. V. N. Kononov. *Trudy Moskov. Vet. Akad.* (Moscow), 23:115 ('58). The usual methods are modified in such a manner that for each detn. 20 drops of water is taken. The amt. of solns. used for titration is also measured by the no. of drops (the same pipet is used in all cases). The results are calcd. by multiplying the no. of drops by the corresponding conversion factor.—*CA*

Conductometric Method of Determination of the Mineralization of Natural Waters With Use of Water Group Coefficients. M. P. Beisova. *Gidrokhim. Materialy* (Moscow), 28:209 ('59). The coeff. relating elec. cond. with water mineralization was calcd. for different types of water, classified according to Alekin. The data are tabulated as to the main types of water (chloride, carbonate, or sulfate type). The avg error of detn. of mineralization with the use of group coeffs. is 4–8%.—*CA*

Study of the Method of Analysis of Fat Materials in Waters. J. Bouquiaux & A. Mertens. *Bul. mens. cebedeau*, No. 110, 42 ('60). Techniques for analyzing for

(Continued on page 92 P&R)

STOP CORROSION . . . IN WATER STORAGE TANKS



with Harco CATHODIC PROTECTION SYSTEMS

Everyday, electrolytic corrosion damages thousands of dollars worth of water storage tanks. Harco specialists can protect your investment with a cathodic system engineered to meet your needs.

Harco job-engineered installations include tests, drawings, materials, and installation as well as periodic maintenance services.

Write today for catalog or call VUlcan 3-8787.

Harco

THE HARCO CORPORATION
4503 East 71st St. • Cleveland 25, Ohio

It will be a long time before anyone sees this piece of Armco pipe again

Steel
Strong
Durable
Economical

Once it is in the ground, Armco Steel Water Pipe is there to stay for years and years. There is less chance of breakage and leakage than with any other kind of pipe.

Because steel is ductile, it yields and deflects—is better able to withstand shock loads. This ductility also eliminates breakage from vibration. In addition, shifting foundations don't bother Armco's flexible non-rigid joints.

Specify Armco Steel Water Pipe and get the strength and durability you want and need. For complete information write to Armco Drainage & Metal Products, Inc., 6281 Curtis Street, Middletown, Ohio.

ARMCO Drainage & Metal Products

(Continued from page 90 P&R)

grease and other fatty materials in water are given. The preferred detn. method is detailed in an appendix.—*PHEA*

Improved Method for Determination of Tracer Quantities of Plutonium in Water. J. Kooi; U. Hollstein; & M. Schlechter. *Proc. U. N. Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva,* 28:565 ('58). Pu in Fe–Cu rich water is concd. by acid $BiPO_4$ pptn. With Fe carrier, Pu is sepd. from Bi by $CHCl_3$ extn. of cupferrates in 0.3*N* HCl. Pu α activity is detd.—*CA*

A Survey of Analytical Methods for the Determination of Strontium in Natural Water. C. A. Horr. *USGS Wtr. Supply Papers* No. 1496-A, ('59). Natural Sr is nontoxic, but Sr^{89} and Sr^{90} are highly toxic. Sr is usually detd. gravimetrically or volumetrically by oxidimetric titration of equiv. oxalate. The most reliable method for sepg. Ca from Sr is extn. with fuming nitric acid. Spectrochem. methods have a reported lower limit of detection of 0.001 ppm. Radiochem. methods for anal. of Sr^{89} and Sr^{90} have been developed. There are no satisfactory direct colorimetric methods for Sr.—*CA*

Evaluating Laboratory Data. H. C. Bramer. *Ind. Wastes,* 5:40 ('60). A technique has been presented by which an effluent stream can be completely described in terms of the variation in concn. of one of its components. Precautions to insure random sampling have been mentioned, and the statistical calculations based on the Central Limit Theorem have been illustrated. The statistical techniques herein are not new; they are well known to statisticians. It is hoped, however, that this paper may encourage the use of this and similar techniques in the water poln. abatement field.—*PHEA*

Field Laboratory Methods for the Determination of Uranium in Nonsaline Waters. G. W. C. Milner & G. A. Barnett. *U.K. At. Energy Authority* C/R 2723 ('58). A direct fluorimetric procedure is described. For waters contg. 1 γ or more of U/l, a 1-ml filtered and acidified sample is evapd. to dryness on a fluorimeter dish in the presence of Mg in AcOH. Fusion in air removes the org. material. The residue is fused with 0.5 g of mixed K_2CO_3–NaF–Na_2CO_3 flux. The fluorescence of the cooled melt is det. with a fluorimeter, and the U cont. is calcd. by comparing with similarly prepd. standards. For waters with U cont. as low as 0.1 γ/l, a 100-ml sample is evapd. and ignited. The residue is dissolved in water, pH adjusted to between 6 and 7 in the presence of (ethylenedinitrilo)tetraacetic acid, and the U extd. as the 8-quinolinol complex in $CHCl_3$. An aliquot of this ext. is used for the fluorimetric detn.—*CA*

On the Behavior of Aqueous Ozone Solutions. F. Sulzer. *Schweiz. Z. Hydrol.* (Switz.), 20:16 ('58). A simple colorimetric ozone anal. technique with o-toluidine reagent was tested and standardized with the aid of the direct spectrophotometric method (absorption at 260 mμ). It is recommended for the measurement of small ozone conts. in aqueous solns. For different waters, the ozone absorption and dissociation curves were specific and the results briefly discussed.—*PHEA*

Modern Analytical Methods for Boiler Feedwater. W. R. Jones. *Ind. Chemist, 36:27,* 34 ('60). Anal. methods are reviewed for the detn. of CO_2, dissolved O, pH, cond., SiO_2, Cu and Fe compds., and carbonates. More convenient methods are needed for the detn. of Cu and Fe.—*CA*

Measurement of Dissolved Oxygen in Swamp Waters. Further Modification of the Winkler Method. L. C. Beadle. *J. Exp. Biol.,* 35:556 ('58). The usual iodine-difference modification of the Winkler method for the detn. of dissolved oxygen cannot be used with accuracy on tropical swamp waters which may be colored and turbid, besides containing large amts. of org. matter, iron, and nitrites. A modification of this method has therefore been developed, involving preliminary clarification of a single sample from which 2 smaller samples are siphoned. The iodine is added to the original sample along with the clarifying reagents, thus avoiding the necessity for quantitative addition of iodine to 2 separate samples, which is another potential source of error in the standard method. The method was found to be accurate to $\pm$0.2 mg/l oxygen. An improved endpoint could be obtained in the titration by means of a magnetic stirrer. It was also found that direct spectrophotometric estn. of iodine was as accurate as, and much more rapid than, titration.—*WPA*

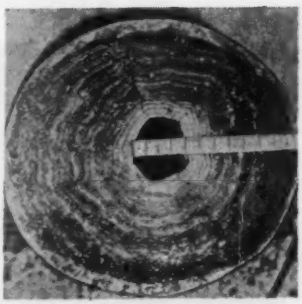
(Continued on page 96 P&R)

YOU WOULDN'T BUILD JUST HALF

A PIPELINE

So Why Use Only HALF of the pipeline you've got!

Neglected city and industrial water pipes fill with deposits like the picture on the right . . . cut down service, and increase fire insurance rates. No half-way methods will cut these rock-hard deposits . . . it takes Ace's modern power equipment. And Ace doesn't merely open the lines . . . they clean them thoroughly, restoring them to their original capacity, at less cost to you. Investigate now!



CALL COLLECT . . . CHestnut 1-2891

CUSTOM-BUILT EQUIPMENT HANDLES ANY JOB, LARGE OR SMALL

ACE

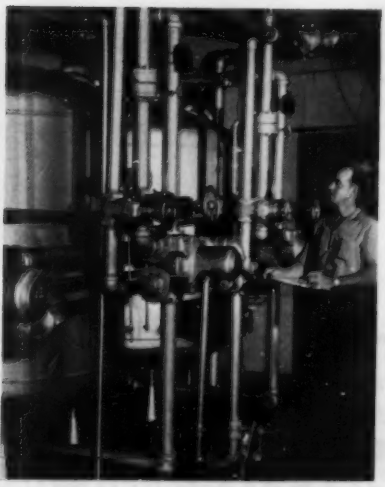
Ace PIPE CLEANING, INC.

4000 East Truman Road, Kansas City 27, Missouri

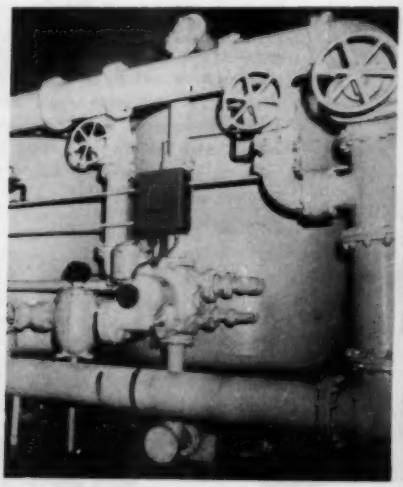
TAKING THE IRON OUT OF WATER

Here's how 4 water plants do it with a minimum of manpower

Dissolved iron (Fe) as high as 10 ppm or more can be decreased to acceptable minimums by Permutit Pressure Filters. Of course, it is necessary to first oxidize the dissolved iron by either aeration or chemical treatment to precipitate it from solution.



Sebree, Kentucky: V. A. Craig, Filter Plant Operator, checks these Permutit Pressure Filters which reduce iron content of city water from 2.5 ppm to 0.1 ppm, and color from 10 to 3. Mayor James Horner reports, "We are pleased with operation; water is much more satisfactory."



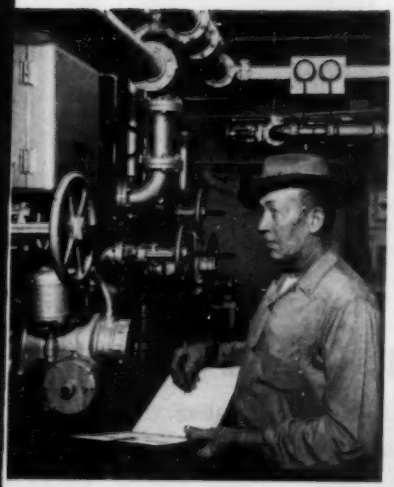
Rushville, Indiana: Here, water from various wells passes through automatically controlled Permutit Pressure Filters and softeners. Iron varies from 4.0 to 10.0 ppm; manganese from 0.00 to 0.3. Both are removed effectively.

With Permutit Pressure Filters, iron reduction as well as color and turbidity removal is accomplished at satisfyingly low cost, both initial and operating. All of the filters shown here are equipped with Permutit's labor-saving Multiport valve which does the work of five separate valves and has but three settings — "backwash", "rinse" and "service". Fully automatic, as well as manual, Multiport Valve controls are available for Permutit Pressure Filters to provide the ultimate in time saving and efficiency.

If you would like to know more about iron removal, or filtration in general, with Permutit Pressure Filters, we will be glad to send you a copy of our Bulletin 2225-C on the subject. Write to: Permutit Division, Pfaudler Permutit Inc., Dept. JA-101, 50 W. 44th St., New York 36, N. Y. In Canada, contact the Permutit Company of Canada, Toronto.

PFAUDLER
PERMUTIT INC.

Specialists in FLUIDICS...the science of fluid processes



Carmel, Indiana: Permutit Pressure Filter and automatic softener equipment here being inspected by Curtis J. Collins, city water superintendent, reduces iron from 1.3 ppm to 0.15 ppm, color from a rating of 35 to between 5 and 10.

Birmingham, Michigan: This high school's water treatment includes (left) Permutit softeners and (right) Permutit Pressure Filters. Three 54" iron removal filters are seen here, each with manually controlled Multiport Valve.

(Continued from page 92 P&R)

SOURCE OF SUPPLY—QUALITY

Drinking Water Quality. R. DEMOLL. *Gas-Wasser-Abwasser* (Vienna), 101:549 ('60). Presently the pop. is increasing in densely settled industrial areas. Consequently, used water must be purified within a limited space to be reused and classified for supply purposes. What threshold taste is permissible in drinking water? This problem is dealt with from the hygienic and from the general environmental and human point of view. Hazards that are not readily subject to control, such as indispensable and undesirable trace materials or radioactivity, are pointed out. Not all poisonous substances are as easily discovered as detergents. Thus, ground water is the most appreciated source of water supply. Its protection and conservation of the environment are most important.—*PHEA*

Mississippi River Water Quality. R. C. PALANGE. *Southwest Wtr. Wks. J.*, 42:23 ('60). USPHS operates a network of 27 sampling stations on the Mississippi River and its tributaries. Org. compds. are concd. through continuous filtration of approx. 5,000 gal over 10- to 14-day periods by using C filters. The org. residues are extd. with $CHCl_3$, then alc. These complex extns. are sepd. into certain broad chem. groups. The $CHCl_3$ and alc. exts. are shown for 8 major stations in ppb and tons/day. Weekly samples for Sr^{90} show a concn. varying from 0.8 to 3.4 $\mu\mu c$/l at New Orleans and St. Louis.—*CA*

Effect of Plastic Pipe and Tank on Drinking Water Quality. W. HERMANOWICZ & Z. TRYWIANSKI. *Gaz, Woda i Tech. Sanitarna* (Warsaw), 34:317 ('60). Polyvinyl-chloride pipe was extd. with (1) distd. H_2O, CO_2 satd. or pure, pH 4.2 or 6.5, at 18–20°C, and (2) tap H_2O (pH 7.7) contg. Fe 0.2, Mn 0.005, Cl^- 114.0, ammonia N 0.6, nitrite N 0.005, and nitrate N 0.15, SO_4^{--} 14.0, dry residue 540.0, and chem. O demand 3.6 mg/l, total and noncarbonate hardnesses 72 and 0 mg/l CaO, total alky. 150 mg/l CaO at 8–20°C. The ratio pipe surface: H_2O vol. was 1:1–1:4. In (1) chem. O demand increased by 0.3–2.3 after 216 hr. In (2), chem. O demand increased by 0.4–1.0 in 72–288 hr, and residual Cl^- decreased by 0.2–0.3 after 120 hr; after 6 days, dry residue was increased by 3–10 and ammonia N decreased by 0.02.—*CA*

Limnology of Selected Arctic Lakes in Relation to Water Supply Problems. W. L. BOYD. *Ecology*, 40:49 ('59). The chem. comp. of arctic lake water changes with increased ice cover, as would be expected. Any type of water treatment for either drinking or boiler purposes must be varied to meet the marked seasonal changes in the qual. of the water. A suitable lake should be over 8 ft in depth, for the greater the depth, the less concn. occurs. A low mineral cont. during the ice-free period is one of the more important criteria in the selection of a potential water supply. Small lakes can be used as temporary summer and early fall sources, but the qual. of water becomes progressively poorer, especially as the ice approaches the bottom of the lake. In general, most of the lakes studied were potable and could serve as a satisfactory water supply, except during and shortly after the runoff period when contamn. from soil water occurred. From the data presented, it seems reasonable to assume that coliform organisms do not survive for long periods in arctic lake water.—*PHEA*

Filter Sand and Gravel

Well Washed and Carefully Graded to Any Specification.
Prompt Shipment in Bulk or in Bags of 100 lb. Each

Inquiries Solicited

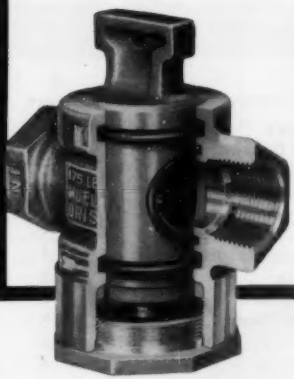
NORTHERN GRAVEL COMPANY

P. O. Box 307 **Muscatine, Iowa**

MUELLER®

ORISEAL® VALVES NOW RATED AT 175 P.S.I. AND 180° F.

The more positive seal provided by the Mueller Oriseal Valve has resulted in both the maximum water working pressure and test pressure being raised 40%... to 175 p.s.i. At the same time, maximum water temperature ratings have been boosted 20% to 180° F. Offering advantages found in no other curb stop, the Oriseal has a "Teflon"* coated, balanced plug that requires no lubrication or maintenance, yet turns freely even after many thousands of operating cycles.



New Oriseal Curb Valve Specifications

Full Round Way Opening • Solid Tee Head with ¼" rod hole • Quarter Turn with Check • 175 p.s.i. Test Pressure (Every Oriseal Valve is tested with 175 p.s.i. air pressure under water in both open and closed positions—a much more exacting test than hydrostatic testing.) • 180°F. Maximum Water Temperature • Sizes: ¾", 1", 1¼", 1½", 2" • Inlet and/or Outlet available with Inside I.P. Thread, Mueller Copper Service Pipe Connection • Available with Minneapolis Pattern in ¾" and 1" sizes

Write for complete information and specifications.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited, Sarnia, Ontario

*DuPont Company registered trademark

6235

Faster LOCATING!
LOWER SERVICE COSTS
with the improved AQUA VALVE BOX LOCATOR!

Your Name In Gold FREE!
$32.50 F.O.B. Cin., Ohio
STOCK this useful tool for every service CAR and CALL •
Speed Locating • Keep Customers Happy
• NO WIRES, BATTERIES or SWITCHES—simple, powerful magnetic action, factory adjusted to YOUR geographical location assures unfailing results!
• NO NEEDLE SPINNING—exclusive electric braking action saves you time!
• NO STOOPING—easy top-view reading!
• RUGGED—compact, accurate, convenient!
• GUARANTEED—to function regardless of weather, surface or ground cover!
• NATION'S MOST WIDELY USED LOCATOR!
• 15-DAY FREE TRIAL—No money! No obligation! You be the judge!
ORDER NOW - Wire or Call
VAlley 1-2514 collect
AQUA SURVEY & INSTRUMENT CO.
7041-J Vine Street, Cincinnati 16, Ohio

FIND LEAKS FASTER
WITH THE AQUA SURVEY AQUAPHONE

Only $4.50 EACH 6 for $25.00 ORDER NOW

RUGGED! SENSITIVE!
Super-sensitive scientific pre-tuned diaphragm without mechanical connection between diaphragm and probe, makes this the industry's most durable instrument. Genuine molded Bakelite case. Unconditionally guaranteed against mechanical failure for life of instrument! Order one for every service man. 2 Ft. probe Extension $2.25.
AQUA SURVEY & INSTRUMENT CO.
7041-J Vine Street, Cincinnati 16, Ohio

Correspondence

Broads Abroad

To the Editor:

Knowing your predilection for conference statistics, I thought you might be interested in a tabulation of the attendance at the recent Berlin Congress of the International Water Supply Assn.:

Country	Registrants	Ladies & Others	Family Man Index %
Germany	407	94	23
Great Britain	150	39	26
France	95	39	41
Sweden	67	31	46
Netherlands	49	7	14
Spain	48	13	27
Belgium	40	11	27
Austria	24	3	13
Switzerland	18	8	44
United States	17	8	47
Finland	16	10	63
Denmark	13	4	31
Italy	9	3	33
Norway	8	4	50
23 other countries	60	9	15
Total	1,021	283	

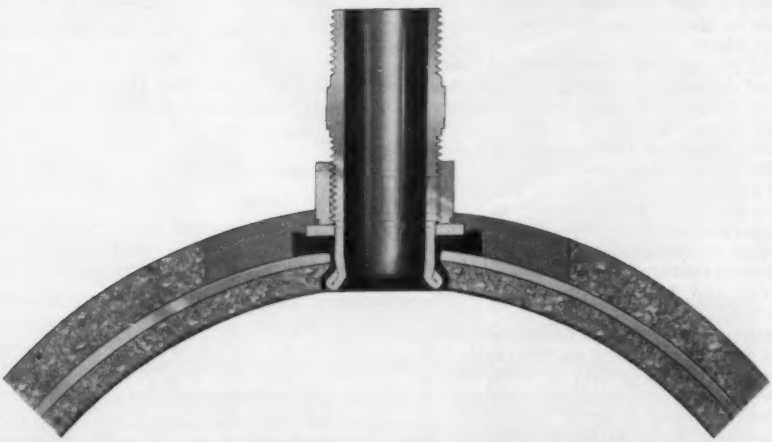
The United States, it will be noted, landed in tenth place, between two remarkably small countries, Finland and Switzerland. It is true that we are rather far away from Berlin, but we are also an affluent society which should be able to afford a little traveling. (The Rome Congress of the International Committee on Large Dams was attended by 62 Americans plus their ladies out of an American committee membership of about 500.)

(*Continued on page 100 P&R*)

introducing an entirely new concept in service connection tapping for steel water pipe

For wet or dry taps...no welding...no costly equipment needed

Fast, permanent service connections can now be made to steel water pipe, cement coated or wrapped, in just 12 minutes... without welding or costly equipment – eliminates cost of conventional tapping-saddle method. In just three easy steps any workman can install trouble-free, watertight 1" and 1½" taps in new or existing systems. Installed with standard wet or dry tapping equipment, Southern Pipe's new tapping outlet of rugged copper with Nitrile Phenolic bushing assures positive, watertight seal for working pressures up to 250 lbs. This tapping method perfected by Southern Pipe through 5 years of research and testing. ■ No exposed steel. ■ No damage to protective cement coating, lining or steel. ■ Standard valves or the cocks can be attached immediately.



See the complete demonstration of this new tapping technique at Booths 5 & 6, California Section of AWWA Convention, Sacramento, Calif., October 24-27. Or call your Southern Pipe Sales Engineer today for details.

USI Southern Pipe

DIVISION OF U. S. INDUSTRIES, INC.

P. O. BOX C, AZUSA, CALIFORNIA • CUMBERLAND 3-7111—EDGEWOOD 7-1221

YOU, IONAC AND

Here's a very inexpensive way to kill foam in seconds in your waste treatment plant.

All you need is a small dose of Ionac liquid defoamer. A steady feed of only ½ to 1 ppm is usually enough to prevent foaming. Or if foam already exists, a slug of 10-30 ppm will knock it flat and keep it down.

You have three types of Ionac Defoamers to select from: a high-temperature type (#1840), one for normal temperatures (#1841), and a low-temperature product that can be stored and fed at sub-zero temperatures (#1842).

You, Ionac and . . . foam-control is just one example of the partnership between you and Ionac, in fluid treatment. Wherever there is a chance to raise efficiency or lower your costs, it takes only a call or letter from you to focus our specialized experience and facilities on your problem.

For details on Ionac Defoamers, or any facts you may need on water treatment chemicals, write: Chemical Service Dept., Ionac Chemical Company, Dept. JA-101, Birmingham, N. J. (In Canada, Pfaudler Permutit Canada Ltd., Toronto.)

IONAC CHEMICAL COMPANY
DIVISION OF PFAUDLER PERMUTIT INC.

Correspondence

(*Continued from page 98 P&R*)

The last column of the table presents a "family man index" in the form of the percentage of participating members accompanied by the wife and kiddies (although the "Others" category also includes secretaries and students). Here the United States is a respectable third, after Finland and Norway. This is quite remarkable considering that the travel costs of the ladies aren't tax deductible. Surprising is the sixth place finish of France—Frenchmen are not such bad family men after all. As the British have always considered such gatherings as a man's world, their eleventh place should surprise nobody. It is surprising, however, that the hosts—the Germans—are twelfth. It is possible, however, that the German ladies were present in Berlin, but not registered.

REMIG A. PAPP

New York, N.Y.; Aug. 26, 1961

Our tenth-place finish is, of course, partly due to the fact that the AWWA Detroit Conference took place about the same time.—ED.

Daminishing Returns

To the Editor:

It appears evident that, in spite of the record of attendance at Detroit, it was not too appealing to the ladies. As evidence, the 1961 attendance by the ladies was the lowest in the last five annual meetings. The drop in the percentage of ladies from 28.7 at Bal Harbour to 17.7 at Detroit represents a reversal of trend and should reduce any fears in the water works industry that it will ultimately be taken over by the ladies.

Perhaps the City Fathers at Detroit might wish to consider directing their public relations advancement toward our better halves so that the future meetings in Detroit will set an even greater record of attendance.

E. A. SIGWORTH

New York, N.Y.; Jun. 28, 1961

* * * *

Next year, we trust, there will be more fillies in Philly.—ED.

PHOTOVOLT
pH Meter Mod. 115

A full-fledged line-operated pH Meter of remarkable accuracy and stability at the low price of

$175

- SIMPLE IN OPERATION AND MAINTENANCE
- FAST AND DEPENDABLE IN SERVICE

Write for Bulletin #225, also for literature on other Line-Operated and Battery-Operated Photovolt pH Meters

PHOTOVOLT CORPORATION

1115 BROADWAY NEW YORK 10, N. Y.

Photometers, Exposure Photometers for Photomicrography, Hemoglobinometers, Polarimeters, Foot-Candle Meters, Interference Filters, Mirror Monochromators

Index of Advertisers' Products

Activated Carbon:
Industrial Chemical Sales Div.
Permutit Co.

Activated Silica Generators:
B-I-F Industries, Inc.—Omega
Wallace & Tiernan Inc.

Aerators (Air Diffusers):
Carborundum Co.
General Filter Co.
Permutit Co.
Walker Process Equipment, Inc.

Air Compressors:
Allis-Chalmers Mfg. Co.
Worthington Corp.

Alum (Sulfate of Alumina):
American Cyanamid Co., Process Chemicals Dept.
General Chemical Div., Allied Chemical Corp.

Ammonia, Anhydrous:
General Chemical Div., Allied Chemical Corp.

Ammoniators:
B-I-F Industries, Inc.—Proportioneers
Fischer & Porter Co.
Wallace & Tiernan Co., Inc.

Ammonium Silicofluoride:
American Agricultural Chemical Co.

Associations, Trade:
American Concrete Pressure Pipe Assn.
Cast Iron Pipe Research Assn.
Steel Plate Fabricators Assn.

Brass Goods:
Anaconda American Brass Co.
Hays Mfg. Co.
Mueller Co.

Brine-Making Equipment:
International Salt Co.

Calcium Hypochlorite:
Olin Mathieson Chemical Corp. (Mathieson Chemicals)

Calculators Hydraulic:
Martin, Robert E.

Carbon Dioxide Generators:
Ozark-Mahoning Co.
Walker Process Equipment, Inc.

Cathodic Protection:
Electro Rust-Proofing Corp.
Harco Corp.

Cement Mortar Lining:
Centriline Corp.
Halliburton Co.
Southern Pipe Div. of U.S. Industries

Chemical Feed Apparatus:
B-I-F Industries, Inc.—Omega
B-I-F Industries, Inc.—Proportioneers
Fischer & Porter Co.
F. B. Leopold Co.
Permutit Co.
Simplex Valve & Meter Co.
Wallace & Tiernan Inc.

Chemists and Engineers:
(See Professional Services)

Chlorination Equipment:
B-I-F Industries, Inc.—Builders
B-I-F Industries, Inc.—Proportioneers
Fischer & Porter Co.
Wallace & Tiernan Inc.

Chlorine Comparators:
Fischer & Porter Co.
Klett Mfg. Co.
Wallace & Tiernan Inc.

Chlorine, Liquid:
Olin Mathieson Chemical Corp. (Mathieson Chemicals)
Wallace & Tiernan Inc.

Clamps and Sleeves, Pipe:
James B. Clow & Sons
Dresser Mfg. Div.
Mueller Co.
A. P. Smith Mfg. Co.
Smith-Blair, Inc.
Trinity Valley Iron & Steel Co.

Clamps, Bell Joint:
James B. Clow & Sons
Dresser Mfg. Div.

Clamps, Pipe Repair:
James B. Clow & Sons
Dresser Mfg. Div.
Smith-Blair, Inc.
Trinity Valley Iron & Steel Co.

Clarifiers:
Dorr-Oliver Inc.
General Filter Co.
Infilco Inc.
Met-Pro, Inc.
Permutit Co.
Walker Process Equipment, Inc.

LaMOTTE CONTROLS

have served the Water Works Engineer for more than 35 years.

Have you sent for the latest booklet on this helpful LaMotte Service?

***For example*—did you know that the LaMotte-Pomeroy Sulfide Testing Outfit determines accurately:**

- **Total Sulfides • Dissolved Sulfides • Hydrogen Sulfide in Sludges and Solutions • Free Hydrogen Sulfide in Air and Gases? •**

We will be happy to send full information on this and other LaMotte units used in the Water Works field.

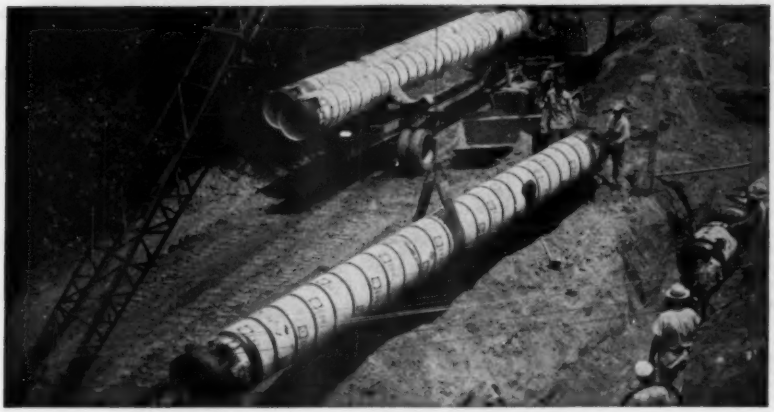
LaMOTTE CHEMICAL PRODUCTS COMPANY

Dept. AWWA Chestertown, Md.

WRITE TODAY For 100 PAGE CATALOG

W. S. DARLEY & CO. Melrose Park, Ill.

ATLANTA *chose* STEEL PIPE



. . . every length was hydrostatically tested in the shop to AWWA standards!

To provide for industrial and residential expansion in South Fulton County, Atlanta Water Works installed an additional 8,200 ft. of steel pipe along Fairburn Road. This new line incudes 2,916 ft. of 36 in. pipe and 6,200 ft. of 30 in. pipe, all with 5/16 in. wall thickness and in 50 ft. lengths.

STRENGTH
TIGHTNESS
ELASTICITY
ECONOMY
LONG LIFE

. . . these are inherent qualities of fabricated *steel* pipe. Compare *steel* pipe with other types . . . you'll see why "wherever water flows, steel pipes it best." You can always specify *steel* pipe with confidence.

For your copy of the latest steel pipe brochure, write—

STEEL PLATE FABRICATORS ASSOCIATION
105 West Madison Street • Chicago 2, Illinois

STEEL PLATE FABRICATORS ASSOCIATION

Coagulant Aids:
Hagan Chemicals & Controls, Inc.
Nalco Chemical Co.
North American Mogul Products Co.
Philadelphia Quartz Co.

Condensers:
Allis-Chalmers Mfg. Co.
Permutit Co.
United States Pipe & Foundry Co.
Worthington Corp.

Contractors, Water Supply:
Layne & Bowler, Inc.

Controllers, Liquid Level, Rate of Flow:
Bailey Meter Co.
B-I-F Industries, Inc.—Builders
Fischer & Porter Co.
Foxboro Co.
General Filter Co.
Simplex Valve & Meter Co.

Copper Sheets:
Anaconda American Brass Co.

Copper Sulfate:
Tennessee Corp.

Corrosion Control:
Calgon Co.
Harco Corp.
Nalco Chemical Co.
North American Mogul Products Co.
Philadelphia Quartz Co.
Southern Pipe Div. of U.S. Industries

Couplings, Flexible:
Dresser Mfg. Div.
Smith-Blair, Inc.
Southern Pipe Div. of U.S. Industries

Covers, Vault:
Ford Meter Box Co.
Wachs, E. H., Co.

Diaphragms, Pump:
Dorr-Oliver Inc.

Engineers and Chemists:
(See Professional Services)

Evaporating Equipment:
Ozark-Mahoning Co.
Permutit Co.

Excavating Equipment:
Charles Machine Works, Inc.

Feedwater Treatment:
B-I-F Industries, Inc.—Proportioneers
Calgon Co.
Hungerford & Terry, Inc.
Nalco Chemical Co.
North American Mogul Products Co.
Permutit Co.

Ferric Sulfate:
Tennessee Corp.

Filter Materials:
Anthracite Equipment Corp.
Carborundum Co.
General Filter Co.
Johns-Manville Corp.
Northern Gravel Co.
Permutit Co.

Filters, incl. Feedwater:
B-I-F Industries, Inc.—Proportioneers
Dorr-Oliver Inc.
Permutit Co.
Ross Valve Mfg. Co.

Filtration Plant Equipment:
B-I-F Industries, Inc.—Builders
B-I-F Industries, Inc.—Omega
Chain Belt Co.
Filtration Equipment Corp.
General Filter Co.
Golden-Anderson Valve Specialty Co.
Hungerford & Terry, Inc.
Infilco Inc.
F. B. Leopold Co.
Permutit Co.
Simplex Valve & Meter Co.
Wallace & Tiernan Inc.

Fittings, Copper Pipe:
Dresser Mfg. Div.
Hays Mfg. Co.
Mueller Co.

Fittings, Tees, Ells, etc.:
American Cast Iron Pipe Co.
James B. Clow & Sons
Dresser Mfg. Div.
M & H Valve & Fittings Co.
Smith-Blair, Inc.
Southern Pipe Div. of U.S. Industries
Trinity Valley Iron & Steel Co.
United States Pipe & Foundry Co.
R. D. Wood Co.

Flocculating Equipment:
Chain Belt Co.
Dorr-Oliver Inc.
General Filter Co.
Infilco Inc.
F. B. Leopold Co.
Met-Pro, Inc.
Permutit Co.

Fluoride Chemicals:
American Agricultural Chemical Co.
General Chemical Div., Allied Chemical Corp.
Olin Mathieson Chemical Corp. (Mathieson Chemicals)
Ozark-Mahoning Co.
Tennessee Corp.

Fluoride Feeders:
B-I-F Industries, Inc.—Omega
B-I-F Industries, Inc.—Proportioneers
Fischer & Porter Co.
Wallace & Tiernan Co., Inc.

Furnaces:
Jos. G. Pollard Co., Inc.

Gages, Liquid Level:
Bailey Meter Co.
B-I-F Industries, Inc.—Builders
Fischer & Porter Co.
Simplex Valve & Meter Co.
Wallace & Tiernan Inc.

Gages, Loss of Head, Pressure of Vacuum, Rate of Flow, Sand Expansion:
Bailey Meter Co.
B-I-F Industries, Inc.—Builders
Fischer & Porter Co.
Foxboro Co.
Jos. G. Pollard Co., Inc.
Simplex Valve & Meter Co.
Wallace & Tiernan Inc.

Gasholders:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Graver Tank & Mfg. Co.
Pittsburgh-Des Moines Steel Co.

Gaskets, Rubber Packing:
James B. Clow & Sons
Johns-Manville Corp.

Gates, Shear and Sluice:
Armco Drainage & Metal Products, Inc.
James B. Clow & Sons
Mueller Co.
R. D. Wood Co.

Gears, Speed Reducing:
DeLaval Steam Turbine Co.
Worthington Corp.

Glass Standards—Colorimetric Analysis Equipment:
Fischer & Porter Co.
Klett Mfg. Co.
Wallace & Tiernan Inc.

Goosenecks (with or without Corporation Stops):
James B. Clow & Sons
Mueller Co.
Southern Pipe Div. of U.S. Industries

Hydrants:
James B. Clow & Sons
Darling Valve & Mfg. Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Hydrogen Ion Equipment:
Photovolt Corp.
Wallace & Tiernan Inc.

Hypochlorite; see Calcium Hypochlorite; Sodium Hypochlorite

Ion Exchange Materials:
General Filter Co.
Hungerford & Terry, Inc.
Nalco Chemical Co.
Permutit Co.
Rohm & Haas Co.

Iron, Pig:
Woodward Iron Co.

Iron Removal Plants:
General Filter Co.
Hungerford & Terry, Inc.
Permutit Co.
Walker Process Equipment, Inc.

Jointing Materials:
Johns-Manville Corp.
Keasbey & Mattison Co.

Joints, Mechanical, Pipe:
American Cast Iron Pipe Co.
James B. Clow & Sons
Dresser Mfg. Div.
Southern Pipe Div. of U.S. Industries
Trinity Valley Iron & Steel Co.
United States Pipe & Foundry Co.
R. D. Wood Co.

Leak Detectors:
Aqua Survey & Instrument Co.
Jos. G. Pollard Co., Inc.

Lime Slakers and Feeders:
B-I-F Industries, Inc.—Omega
Dorr-Oliver Inc.
General Filter Co.
Infilco Inc.
Permutit Co.
Wallace & Tiernan Inc.

Locators, Pipe & Valve Box:
Aqua Survey & Instrument Co.
W. S. Darley & Co.
Jos. G. Pollard Co., Inc.

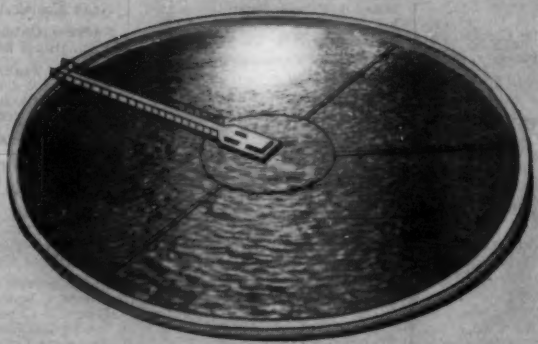
Magnetic Dipping Needles:
Aqua Survey & Instrument Co.
W. S. Darley & Co.

Meter Boxes:
Ford Meter Box Co.
Rockwell Mfg. Co.

Meter Couplings and Yokes:
Badger Meter Mfg. Co.
Dresser Mfg. Div.
Ford Meter Box Co.
Gamon Meter Div., Worthington Corp.

Is YOUR Water Problem Iron and Manganese Removal?

Ferri-Floc
FERRIC SULFATE



We can solve your iron and manganese removal problem by coagulation in the high pH range. Let one of our experienced technicians demonstrate this and other reasons why Ferri-Floc will perform more efficiently in your plant.

Also basic producers of
SODIUM SILICOFLUORIDE
COPPER SULFATE

Phone JAckson 3-5024 or write.

TC TENNESSEE CORPORATION
612-629 Grant Building, Atlanta 3, Georgia

Hays Mfg. Co.
Hersey-Sparling Meter Co.
Mueller Co.
Neptune Meter Co.
Rockwell Mfg. Co.
Smith-Blair, Inc.

Meter Reading and Record Books:
Badger Meter Mfg. Co.

Meter Testers:
Badger Meter Mfg. Co.
Ford Meter Box Co.
Hersey-Sparling Meter Co.
Neptune Meter Co.
Rockwell Mfg. Co.

Meters, Domestic:
Badger Meter Mfg. Co.
Buffalo Meter Co.
Gamon Meter Div., Worthington Corp.
Hersey-Sparling Meter Co.
Neptune Meter Co.
Rockwell Mfg. Co.

Meters, Filtration Plant, Pumping Station, Transmission Line:
Bailey Meter Co.
B-I-F Industries, Inc.—Builders
Fischer & Porter Co.
Simplex Valve & Meter Co.

Meters, Industrial, Commercial:
Badger Meter Mfg. Co.
Bailey Meter Co.
B-I-F Industries, Inc.—Builders
Buffalo Meter Co.
Fischer & Porter Co.
Gamon Meter Div., Worthington Corp.
Hersey-Sparling Meter Co.
Neptune Meter Co.
Rockwell Mfg. Co.
Simplex Valve & Meter Co.

Mixing Equipment:
General Filter Co.
F. B. Leopold Co.

Motors, Electric:
Allis-Chalmers Mfg. Co.
Worthington Corp.

Paints:
Inertol Co., Inc.
Koppers Co., Inc.
Plastics & Coal Chemicals Div., Allied Chemical Corp.

Pipe, Asbestos-Cement:
Atlas Asbestos Co. Ltd.
Johns-Manville Corp.
Keasbey & Mattison Co.

Pipe, Brass:
Anaconda American Brass Co.

Pipe, Cast Iron (and Fittings):
Alabama Pipe Co.
American Cast Iron Pipe Co.
James B. Clow & Sons
Trinity Valley Iron & Steel Co.
United States Pipe & Foundry Co.
R. D. Wood Co.

Pipe, Cement Lined:
American Cast Iron Pipe Co.
James B. Clow & Sons
Southern Pipe Div. of U.S. Industries
United States Pipe & Foundry Co.
R. D. Wood Co.

Pipe, Concrete:
American Pipe & Construction Co.
Lock Joint Pipe Co.

Pipe, Copper:
Anaconda American Brass Co.

Pipe, Plastic:
Keasby & Mattison Co.
Orangeburg Mfg. Co., Div. of The Flintkote Co.

Pipe, Steel:
Armco Drainage & Metal Products, Inc.
Bethlehem Steel Co.
Southern Pipe Div. of U.S. Industries

Pipe Cleaning Services:
Ace Pipe Cleaning, Inc.
Centriline Corp.
National Power Rodding Corp.
National Water Main Cleaning Co.
Robinson Pipe Cleaning Co.

Pipe Coatings and Linings:
American Cast Iron Pipe Co.
Centriline Corp.
Inertol Co., Inc.
Koppers Co., Inc.
Pipe Linings, Inc.
Plastics & Coal Chemicals Div., Allied Chemical Corp.
Southern Pipe Div. of U.S. Industries

Pipe Cutters:
James B. Clow & Sons
Ellis & Ford Mfg. Co.
Pilot Mfg. Co.
Jos. G. Pollard Co., Inc.
A. P. Smith Mfg. Co.
Wachs, E. H., Co.
Wheeler Mfg. Corp.

Pipe Jointing Materials; see Jointing Materials

Pipe Locators; see Locators, Pipe

Plugs, Removable:
James B. Clow & Sons
Jos. G. Pollard Co., Inc.
A. P. Smith Mfg. Co.

Potassium Permanganate:
Carus Chemical Co.

Pressure Regulators:
Allis-Chalmers Mfg. Co.
Golden-Anderson Valve Specialty Co.
Mueller Co.
Ross Valve Mfg. Co.

Pumps, Boiler Feed:
DeLaval Steam Turbine Co.

Pumps, Centrifugal:
Allis-Chalmers Mfg. Co.
DeLaval Steam Turbine Co.
Peerless Pump Div.
C. H. Wheeler Mfg. Co.

Pumps, Chemical Feed:
B-I-F Industries, Inc.—Proportioneers
Fischer & Porter Co.
Wallace & Tiernan Inc.

Pumps, Deep Well:
Layne & Bowler, Inc.
Peerless Pump Div.

Pumps, Diaphragm:
Dorr-Oliver Inc.
Wallace & Tiernan Inc.

Pumps, Hydrant:
W. S. Darley & Co.
Jos. G. Pollard Co., Inc.

Pumps, Hydraulic Booster:
Peerless Pump Div.
Ross Valve Mfg. Co.

Pumps, Sewage:
Allis-Chalmers Mfg. Co.
DeLaval Steam Turbine Co.
Peerless Pump Div.
C. H. Wheeler Mfg. Co.

Pumps, Sump:
DeLaval Steam Turbine Co.
Peerless Pump Div.
C. H. Wheeler Mfg. Co.

Pumps, Turbine:
Layne & Bowler, Inc.
Peerless Pump Div.

Recorders, Gas Density, CO_2, NH_3, SO_2, etc.:
Fischer & Porter Co.
Permutit Co.
Wallace & Tiernan Inc.

Recording Instruments:
Bailey Meter Co.
B-I-F Industries, Inc.—Builders
Fischer & Porter Co.
Simplex Valve & Meter Co.
Wallace & Tiernan Inc.

Reservoirs, Steel:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Graver Tank & Mfg. Co.
Pittsburgh-Des Moines Steel Co.

Sand Expansion Gages; see Gages

Sleeves: see Clamps

Sleeves and Valves, Tapping:
James B. Clow & Sons
M & H Valve & Fittings Co.
Mueller Co.
A. P. Smith Mfg. Co.

Sludge Blanket Equipment:
General Filter Co.
Infilco Inc.
Met-Pro, Inc.
Permutit Co.

Sodium Aluminate:
Nalco Chemical Co.

Sodium Chloride:
International Salt Co.

Sodium Fluoride:
American Agricultural Chemical Co.
General Chemical Div., Allied Chemical Corp.

Sodium Hexametaphosphate:
Calgon Co.

Sodium Hypochlorite:
Wallace & Tiernan Inc.

Sodium Silicate:
General Chemical Div., Allied Chemical Corp.
Philadelphia Quartz Co.

Sodium Silicofluoride:
American Agricultural Chemical Co.
General Chemical Div., Allied Chemical Corp.
Tennessee Corp.

Softeners:
Dorr-Oliver Inc.
General Filter Co.
Hungerford & Terry, Inc.
Permutit Co.
Walker Process Equipment, Inc.

Softening Chemicals and Compounds:
Calgon Co.
General Filter Co.
International Salt Co.
Nalco Chemical Co.
Permutit Co.
Tennessee Corp.

Standpipes, Steel:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Graver Tank & Mfg. Co.
Pittsburgh-Des Moines Steel Co.

MH Roll-call for water

the Bird Woman's home

When Lewis and Clark first explored western United States, they found an exceptional Indian woman in what is now Missouri. Her name was Sacajawea (said to mean bird woman) and her services as guide and interpreter to the expedition were invaluable. It was a wild and rough journey. There were no cities and no public water distribution system in the Prairie Belt states in those days. But the report of their expedition inspired thousands of eastern people to organize wagon trains and start West from St. Louis, as Lewis and Clark had done, up the Missouri River and her tributaries.

Today this Prairie Belt of 7 west-north-central States produces grain and is sometimes called America's bread basket. The Indians and the buffalo are gone. In their place are modern farms, homes, highways, railways, airports and cities. Of the 40 cities of 25,000 population or more, 29 have adequate water systems, 5 have water works of uncertain efficiency, and 6 have water works which are definitely deficient in overload capacity.

Minnesota
Iowa
Missouri
North Dakota
South Dakota
Nebraska
Kansas

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

Steel Plate Construction:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Graver Tank & Mfg. Co.
Pittsburgh-Des Moines Steel Co.

Stops, Curb and Corporation:
Ford Meter Box Co.
Hays Mfg. Co.
Mueller Co.

Storage Tanks: see Tanks

Strainers, Suction:
James B. Clow & Sons
R. D. Wood Co.

Surface Wash Equipment:
Golden-Anderson Valve Specialty Co.
Permutit Co.

Swimming Pool Sterilization:
B-I-F Industries, Inc.—Builders
B-I-F Industries, Inc.—Omega
B-I-F Industries, Inc.—Proportioneers
Fischer & Porter Co.
Wallace & Tiernan Inc.

Tank Painting and Repair:
Koppers Co., Inc.
National Tank Maintenance Corp.

Tanks, Prestressed Concrete:
Preload Co., Inc.

Tanks, Steel:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Graver Tank & Mfg. Co.
Pittsburgh-Des Moines Steel Co.

Tapping-Drilling Machines:
Hays Mfg. Co.
Mueller Co.
A. P. Smith Mfg. Co.

Tapping Machines, Corp.:
Hays Mfg. Co.
Mueller Co.

Taste and Odor Removal:
B-I-F Industries, Inc.—Builders
B-I-F Industries, Inc.—Proportioneers
General Filter Co.
Industrial Chemical Sales Div.
Met-Pro, Inc.
Permutit Co.
Wallace & Tiernan Inc.

Turbidimetric Apparatus (For Turbidity and Sulfate Determinations):
Wallace & Tiernan Inc.

Turbines, Steam:
Allis-Chalmers Mfg. Co.
DeLaval Steam Turbine Co.

Valve Boxes:
James B. Clow & Sons
Ford Meter Box Co.
M & H Valve & Fittings Co.
Mueller Co.
Rockwell Mfg. Co.
A. P. Smith Mfg. Co.
Trinity Valley Iron & Steel Co.
R. D. Wood Co.

Valve-Inserting Machines:
Mueller Co.
A. P. Smith Mfg. Co.

Valve-Operating Units:
B-I-F Industries, Inc.
Filtration Equipment Corp.
Wachs, E. H., Co.
Wheeler, C. H., Mfg. Co.

Valves, Altitude:
Allis-Chalmers Mfg. Co., Hydraulic Div.
Golden-Anderson Valve Specialty Co.
Ross Valve Mfg. Co., Inc.

Valves, Butterfly, Check, Flap, Foot, Hose, Mud and Plug:
Allis-Chalmers Mfg. Co., Hydraulic Div.
B-I-F Industries, Inc.—Builders
James B. Clow & Sons
DeZurik Corp.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Pelton Div., Baldwin-Lima-Hamilton
Rockwell Mfg. Co.
R. D. Wood Co.

Valves, Detector Check:
Hersey-Sparling Meter Co.

Valves, Electrically Operated:
Allis-Chalmers Mfg. Co., Hydraulic Div.
B-I-F Industries, Inc.—Builders
James B. Clow & Sons
Darling Valve & Mfg. Co.
Golden-Anderson Valve Specialty Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Rockwell Mfg. Co.
A. P. Smith Mfg. Co.

Valves, Float:
James B. Clow & Sons
Golden-Anderson Valve Specialty Co.
Rockwell Mfg. Co.
Ross Valve Mfg. Co., Inc.

Valves, Gate:
James B. Clow & Sons
Darling Valve & Mfg. Co.
Dresser Mfg. Div.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Hydraulically Operated:
Allis-Chalmers Mfg. Co., Hydraulic Div.
B-I-F Industries, Inc.—Builders
James B. Clow & Sons
Darling Valve & Mfg. Co.
DeZurik Corp.
Golden-Anderson Valve Specialty Co.
Kennedy Valve Mfg. Co.
F. B. Leopold Co.
M & H Valve & Fittings Co.
Mueller Co.
Rockwell Mfg. Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Large Diameter:
Allis-Chalmers Mfg. Co., Hydraulic Div.
James B. Clow & Sons
Darling Valve & Mfg. Co.
Golden-Anderson Valve Specialty Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Rockwell Mfg. Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Regulating:
Allis-Chalmers Mfg. Co., Hydraulic Div.
DeZurik Corp.
Golden-Anderson Valve Specialty Co.
Mueller Co.
Rockwell Mfg. Co.
Ross Valve Mfg. Co.

Valves, Swing Check:
James B. Clow & Sons
Darling Valve & Mfg. Co.
Golden-Anderson Valve Specialty Co.
M & H Valve & Fittings Co.
Mueller Co.
Rockwell Mfg. Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Venturi Tubes:
B-I-F Industries, Inc.—Builders
Rockwell Mfg. Co.
Simplex Valve & Meter Co.

Waterproofing:
Inertol Co., Inc.
Koppers Co., Inc.
North American Mogul Products Co.
Plastics & Coal Chemicals Div., Allied Chemical Corp.

Water Softening Plants; see Softeners

Water Supply Contractors:
Layne & Bowler, Inc.

Water Testing Apparatus:
LaMotte Chem. Products Co.
Wallace & Tiernan Inc.

Water Treatment Plants:
Chain Belt Co.
Chicago Bridge & Iron Co.
Dorr-Oliver Inc.
General Filter Co.
Hungerford & Terry, Inc.
Infilco Inc.
Met-Pro, Inc.
Permutit Co.
Pittsburgh-Des Moines Steel Co.
Walker Process Equipment, Inc.
Wallace & Tiernan Inc.

Well Drilling Contractors:
Layne & Bowler, Inc.

Well Reconditioning and Formation Testing:
Halliburton Co.
Layne & Bowler, Inc.

Wrenches, Ratchet:
Dresser Mfg. Div.

Zeolite: see Ion Exchange Materials

A complete Buyers' Guide to all water works products and services offered by AWWA Associate Members appears in the 1961 AWWA Directory.

Before you buy any storage tank..

take a look at

No matter what your storage problem, a prestressed concrete tank offers many immediate and long term advantages. Minimum maintenance, longest service life, lowest overall cost, 75% of construction cost is spent locally. Modern in engineering and design, proven in service, lowest in cost...prestressed concrete should be considered in any tank planning.

Send for your copy of our new brochure "Prestressed Concrete Tanks."

PRELOAD

PRESTRESSED CONCRETE

THE PRELOAD COMPANY, INC.
355 Lexington Ave., New York 17, N. Y. • Tel.: MUrray Hill 7-0488
1216 Hartford Bldg., Dallas 1, Texas • Tel.: Riverside 8-4047

PRELOAD CONCRETE STRUCTURES INC.
837 Old Country Rd.
Westbury, L. I., N. Y.

THE CANADA GUNITE COMPANY, LTD.
125 Nymus Blvd.
Pointe Claire, P.Q., Can.

HERRICK IRON WORKS
P.O. Box 3007
25450 Clawiter Rd.
Hayward 2, Calif.

Strong as a SAFE

yet easily handled by one man

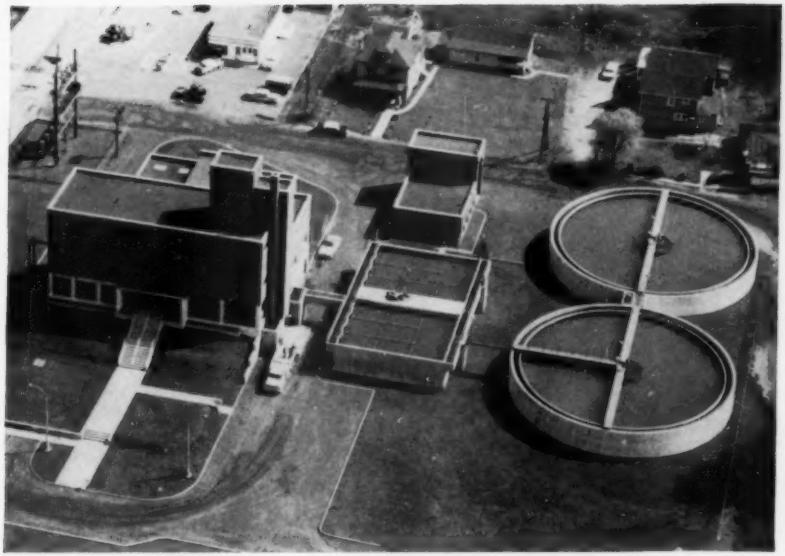
The FORD YOKEBOX keeps shallow service meters—SAFE from dirt, insects, or larger pests. Cast iron, unbroken barrier on all sides. Keeps dials clean for fast, accurate reading.
SAFE from tampering. Locking lid opens only with *lifter* key. Lockless lid also available.
SAFE for pedestrians. Anchor lugs (optional) prevent settling in concrete.
Each Ford Yokebox includes service valve, expansion coupling and service line connections.
Proven for year 'round settings as far north as Virginia. A boon to northern resort areas where lines are drained and meters removed for winter. Make meter changing quick and trouble-free. Prolong meter life.

Battery setting easily read with one stop.

FORD

for *better* water services

THE FORD METER BOX COMPANY, INC., Wabash, Indiana



ASHLAND, Ky.'s NEW PLANT

Treats Ohio River Water in Dorr-Oliver Equipment

A quarter-century ago, the City of Ashland, Kentucky, installed a new water treatment plant which incorporated Dorrco® Flocculators. Today, removed from the earlier plant's flood-ridden area, an entirely new plant has been constructed, again incorporating Dorr-Oliver treatment units.

Located above the highest flood level, the new plant provides flocculation and clarification for 8 mgd of Ohio River water, with provision for expansion. These steps are carried out in one Dorrco TEQ Flash Mixer; two Dorrco Type T Flocculators with three rows of paddles 12′6″ dia.; and two Dorr Type S-7 Clarifiers 90′ dia. x 14′ s.w.d. – one equipped with T-type walkway.

Dorr-Oliver offers a wide range of equipment for the treatment of municipal water supplies. For complete information write Dorr-Oliver Incorporated, Stamford, Conn.

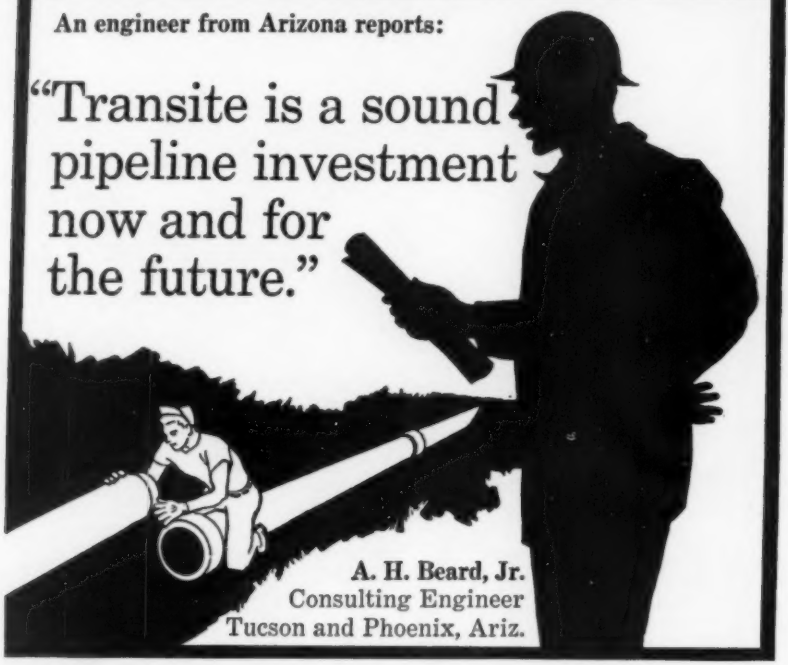
Consulting Engineers: Alfred LeFeber & Associates, Cincinnati, Ohio
Contractor: Wellsbach Corporation, Philadelphia, Penna.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

An engineer from Arizona reports:

"Transite is a sound pipeline investment now and for the future."



A. H. Beard, Jr.
Consulting Engineer
Tucson and Phoenix, Ariz.

"When considering a pipe material for water and sewage projects, 'value' analysis plays an important part in our choice. One of the main questions is whether the pipe will perform reliably now *and* in the future with cost advantages to the client.

"Experience has shown that Johns-Manville Transite® Pipe offers the value we seek. It has proved reliable and at very favorable costs. In addition to savings in handling and installing, Transite's unique Ring-Tite® joints assure that leakage tests will not upset job costs. In numerous tests, Transite lines have regularly been under the 'allowable' specification.

"Installations as old as Transite itself show this pipe outstanding under flexure, crush and hydrostatic conditions. Lengths of Transite excavated here in Arizona for tests showed no signs of internal corrosion after 20 years of dependable service."

For full details, write to Johns-Manville, Box 362, JA-10, N. Y. 16, N. Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.

JOHNS-MANVILLE

JM

10

PART 2

Journal

AMERICAN WATER WORKS ASSOCIATION

October 1961 Vol. 53, No. 10

TWO PARTS
PART 2
(Journal is Part 1)

AWWA DIRECTORY

1961 • REFERENCE EDITION

AWWA ACTIVITIES & DATA

Committee List • Constitution & Bylaws • Honorary Awards • AWWA Publications • Membership Summary • Water Supply Library

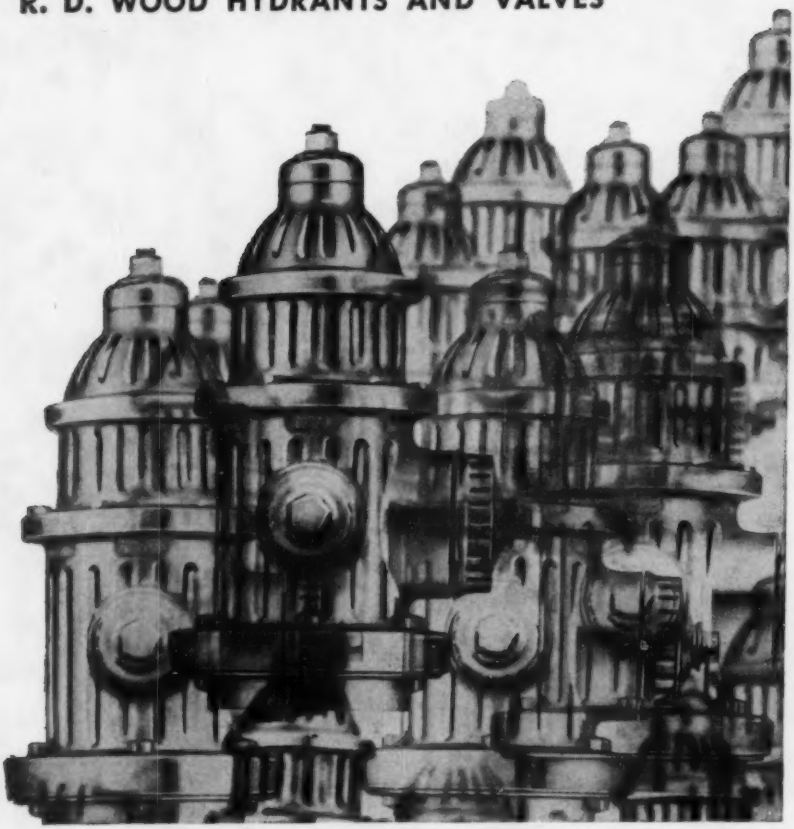
MATERIALS & SERVICES GUIDE

Classified List of Products • Main & Branch Offices of Manufacturers • Distributors & Representatives • Consultants

OVER A MILLION REASONS

WHY YOU SHOULD SPECIFY

R. D. WOOD HYDRANTS AND VALVES



Reasons? Over a million hydrants now in service throughout the world. A number like that speaks for itself, says plenty about the outstanding features of the hydrant and the excellent service and reliability you can expect with R. D. Wood products.

Conform to A.W.W.A. specifications

R. D. WOOD COMPANY

Public Ledger Bldg., Independence Square, Philadelphia 6, Pa.

Established in 1803

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds)

AWWA Directory

· 1961 ·

REFERENCE EDITION

Contents

Introduction	2	Summary of Membership	46
Local Sections and Functional Divisions	3	Directory of Committees	47
Constitution and Bylaws	5	AWWA Publications	63
Standardization Procedure	23	Water Supply Library	71
Use of AWWA Seal	27	Professional Services	82
Use of AWWA Membership Lists	27	Tank Painting and Repairing Services	94
Quotation and Reprinting Rules	28	Water Works Buyers' Guide	
Statements of Policy on Section Activities	30	Liquid-Chlorine Producers	96
Advancement Award Rules	33	Associate Members (Main and Branch Offices, Distributors and Representatives)	131
AWWA Safety Award Plan	34	Buyers' Guide	149
AWWA Code of Practice	36	List of Advertisers	174
Honorary Awards	38	Directory of Consultants	177
Conventions and Past-Presidents	44		

The Reference Edition of the AWWA Directory is published in odd-numbered years; the Membership List Edition, in even-numbered years. The next list of members will appear in 1962 (members joining between editions are listed in the monthly *Willing Water*).

Advertising space in the Directory is made available only to individuals and firms holding membership in AWWA.

Copyright © 1961 by the American Water Works Association, Inc.

as Part 2 of Journal AWWA, Vol. 53, No. 10

Made in USA

AMERICAN WATER WORKS ASSOCIATION, INC.

2 Park Avenue **New York 16, N.Y.**

INTRODUCTION

THE American Water Works Association was organized in 1881 to "advance the knowledge of the design, construction, operation, and management of water works." Its activities in part are developed through regional or state Sections, in part through general Divisions, and in part through standing committees.

There are at present 33 regional or state Sections. The largest ones are in California, the Southwest, and New York. Each Section has at least one meeting each year, with attendance totals ranging from 100 to more than 1,700 interested persons. Papers are presented; round-table discussions are held; tests are made; products are sometimes exhibited—all calculated to improve water works design and management in the Section area.

There are four professional Divisions of the Association: Management; Water Resources; Water Purification; and Distribution. The programs at the Annual Conferences of the Association are built around the activities of these Divisions, whose chairmen are ex officio members of the Technical Program Committee.

Other technical activities of the Association are organized under four standing committees: Committee on Standardization; Committee on Professional and Administrative Practice; Committee on Research; and Committee on Education. These are groups of men selected to provide a cross section of the Association's field of interest, in the person of leaders in the field. Operating under the supervision of these committees are more than 100 working committees to which specific subjects have been assigned.

The JOURNAL AWWA is a monthly publication which totals approximately 3,000 pages per year. In it are found the papers and reports on water works subjects deemed to have permanent or major value to the field. About 100 pages annually are devoted to abstracts of articles the world over which relate to all aspects of water works affairs. No comparable cross section of data exists elsewhere. An Index to the JOURNAL for 1940–55 has been issued. In addition, a detailed index to each annual volume of the JOURNAL appears in the December issue.

Another publication distributed to AWWA members is *Willing Water*, a monthly bulletin devoted to public relations, safety, defense, and other special problems.

The Association maintains headquarters at 2 Park Avenue, New York 16, N.Y., with a full-time staff of twenty persons available for conference or correspondence on matters of general water works interest.

LOCAL SECTIONS

There have been established 33 local Sections, under the provisions of Article VIII of the Association's Bylaws. Each member of AWWA is normally a member of the Section in whose territory he resides or works.

Each local Section has its own officers, as listed each month in the JOURNAL. These officers are all selected by the Section itself under the provisions of the bylaws of that Section. One of these officers is a member selected to represent his Section on the Board of Directors of the American Water Works Association, in accordance with Article III of the Association's Constitution.

The local Sections each hold one or more meetings during the year, their practice in this respect, as well as the conduct of all of their business, being adapted to meet best the needs of their respective territories. Papers presented at the local Section meetings are drawn upon for publication in the JOURNAL AWWA.

Many of the Association's Sections hold each year one or more schools, conferences, or in-service training institutes, and several cooperate in the procedure within their states which licenses the operators of water treatment plants. This is done in order to insure to the various communities as permanent and well trained personnel as can be provided.

FUNCTIONAL DIVISIONS

In accordance with the provisions of Article VIII of the Association's Bylaws, the Board of Directors has established four functional Divisions, consisting of members who are particularly interested in certain branches of the water supply industry:

Water Works Management Division. By the organization of the Water Works Management Division in 1948, the previous Plant Management and Operation Division, established in 1924, and the Finance and Accounting Division, established in 1929, were terminated. The new Division combines the functions of both, taking as its specific fields of interest the financing, management, commercial practices, and accounting procedures of water utilities. Additions to knowledge and the improvement of practices within these fields are the objectives of the Division.

Water Resources Division. The conservation and orderly development of both surface and ground waters, and the control of water pollution as it affects the economics of water supply, are the field of interest of the Water Resources Division. The Division was organized in 1948.

Water Purification Division. This Division was organized originally as the Chemical and Bacteriological Section in 1913. The present name was adopted in 1925. The objects of this Division include: the advancement of the science and art of water treatment; the study of the causes and effects of pollution and methods of treatment to combat it; and the promotion of progress in the design, construction, and operation of treatment plants.

Distribution Division. The scope of the Distribution Division, which was organized in 1952 as the Transmission and Distribution Division, includes design, construction, operation, and maintenance activities in the fields of power, pumping, transmission, distribution, customer services, and metering of public water supply.

The principal activities of the Divisions take place during the Annual Conference of the Association, at which time a number of the technical sessions are held under the auspices of the Divisions. These sessions are presided over by the officers of the Division concerned and the subjects of discussion are those in which the Division is interested. The Division may also appoint task groups to explore subjects of interest to them with a view to recommending the establishment of formal committees under standing committee procedure.

CONSTITUTION AND BYLAWS

of the

AMERICAN WATER WORKS ASSOCIATION

with

STATEMENTS OF POLICY

AMERICAN WATER WORKS ASSOCIATION
Incorporated
2 Park Avenue, New York 16, N.Y.

The present Constitution and Bylaws, approved in 1960, became effective Jan. 1, 1961, superseding the former constitution and bylaws (originally adopted in 1929) on that date. The text that follows includes all amendments made to the date of issuance of this Directory.

CONSTITUTION

ARTICLE I

Name and Composition

Sec. 1. *Name.* The name of this Association shall be "The American Water Works Association" (abbreviated "AWWA").

Sec. 2. *Membership:*

2.1. The membership of the Association shall consist of persons and organizations interested in and in accord with the objects set forth in Art. II. Qualifications for and classification of membership shall be as prescribed in the Bylaws.

2.2. The term "Active Member" as used in this Constitution shall include all persons having the rights and privileges of Active Members under the Bylaws.*

Sec. 3. *Local Sections.* There shall be local Sections established by the Board of Directors as prescribed in the Bylaws.

(*Constitution*)

ARTICLE II

Objects

The objects of the Association shall be:

a. To advance the knowledge of the design, construction, operation, and management of water utilities

b. To consider and deal with the problems involved in the production and distribution of safe and adequate water supplies

c. To promote satisfactory relationships with the consuming public

d. To give proper consideration to and express opinions upon practices which will enable the industry to render the best possible service to the public

e. To do whatever things are necessary and proper for the accomplishment of the objects herein set forth, all of which shall be consistent with the public interest and with the interests of the public water supply field.

(*Constitution*)

ARTICLE III

Board of Directors

Sec. 1. *Function.* The affairs of the Association shall be managed by a Board of Directors. The Board may enact bylaws not inconsistent with the provisions of this Constitution.

Sec. 2. *Membership:*

2.1. The Board shall consist of:

a. The President of the Association

b. The Vice-President of the Association

c. The Treasurer of the Association

d. The latest living Past-President of the Association

e. One Director to be elected by each Section of the Association

* The Bylaws currently grant such rights and privileges to Honorary and Life Members, as well as to accredited representatives of Corporate Members or Municipal Service Subscribers.

f. Three Directors to be designated by the Water and Sewage Works Manufacturers Association

g. Such Standing Committee chairmen as the Bylaws may designate.

2.2. No Board member may be represented by any other person in any action required of him as a Board member.

2.3. No officer shall serve as a Director representing a Section or the Water and Sewage Works Manufacturers Association, nor shall any Director represent both the Manufacturers Association and an AWWA Section at one time.

Sec. 3. *Quorum.* A quorum of the Board shall consist of a majority of its members.

Sec. 4. *Meetings.* Regular meetings of the Board shall be held in January of each year and, also, at the time and place of the annual convention, on such days as may be fixed by the Board. Special meetings may be held at the direction of the President, or at the written request of five members of the Board, and on such notice as shall be prescribed in the Bylaws.

Sec. 5. *Executive Committee.* The Board shall appoint an Executive Committee of seven of its members, including the President, Vice-President, Treasurer, and latest living Past-President. Between meetings of the Board, the Executive Committee shall, to the extent provided in the Bylaws, have and exercise all of the authority of the Board in the management of the Association. Four members of the Executive Committee shall constitute a quorum thereof, but no action shall be taken without the concurrence of a majority of the whole Committee.

Sec. 6. *Term of office:*

6.1. The terms of Directors representing Sections or the Water and Sewage Works Manufacturers Association shall be for approximately three years.

6.2. In a year when the annual convention is scheduled to begin before August 15, the terms of newly selected Directors shall commence—and the terms of their predecessors shall end—at 12:01 AM of the last scheduled day of the convention.

6.3. In a year when the annual convention is not to be held, or will not begin before August 15, the terms of newly selected Directors shall commence—and the terms of their predecessors shall end—at 12:01 AM on July 1.

6.4. Sections 6.2 and 6.3 notwithstanding, a Director shall continue in office beyond the prescribed expiration date of his term if his successor has not been chosen before then. In that case, his tenure shall end and his successor's tenure shall begin when notice of selection is acknowledged by the Executive Secretary. But no Director's tenure shall be extended beyond the conclusion of the next regular meeting of the Board (Art. III, Sec. 4). The expiration date of a Director's term shall not be changed by reason of his taking office after the normal commencement date.

6.5. The Board shall fix the limits of the term of the first Director representing a newly established Section.

6.6. No Director shall serve a second term consecutively. This prohibition shall not apply to a Director chosen to fill out an unexpired portion of a predecessor's term if selected subsequent to the annual convention first preceding the end of the term.

Sec. 7. *Manner of selection:*

7.1. Directors representing Sections shall be selected as follows:

7.1.1. Each Section shall elect one Director from among its Active Members, in a manner consistent with its bylaws. If a Director ceases to be a member of the Section that elected him, he shall be replaced as prescribed in Sec. 7.1.2 of this Article.

7.1.2. When, for any reason, a Director fails to complete his term, a successor to serve for the remainder of the term shall be elected by the Section members as prescribed in the bylaws of the Section or appointed by the governing body of the Section.

7.2. The Water and Sewage Works Manufacturers Association shall designate three Directors. If such a Director fails to complete his term, the Manufacturers Association shall designate a successor to serve for the remainder of the term.

(*Constitution*)

ARTICLE IV

Officers

Sec. 1. *Titles and functions.* The officers of the Association shall consist of the following:

1.1. The *President,* who shall have general supervision of the affairs of the Association, performing such additional duties as the Bylaws may prescribe.

1.2. The *Vice-President,* who shall assist the President in the performance of his duties and act in his stead when required.

1.3. The *Treasurer,* who shall have supervision of the funds of the Association, carrying out his responsibilities in regard to them as the Board of Directors may require.

1.4. The *Executive Secretary,* who shall be the chief administrator of the Association.

Sec. 2. *Terms of office:*

2.1. The terms of the President, Vice-President, and Treasurer shall be for approximately one year, with the limits to be fixed as provided for Directors in Art. III, Sec. 6.2 and 6.3. These officers shall, however, continue in office until their successors have been chosen. The Executive Secretary shall serve at the pleasure of the Board, but the Executive Committee shall have power to suspend him from office if such action is clearly in the interest of the Association.

2.2. If the President fails to complete his term, the Vice-President shall act in his stead for the remainder of the term. If the Vice-President cannot act, the latest living Past-President shall do so. If the Past-President cannot act, the Executive Committee shall appoint an Acting President. If the Treasurer fails to complete his term, the Executive Committee shall appoint an Acting Treasurer. Such appointees must meet the qualifications set forth in Sec. 3.1 of this Article.

2.3. Neither the President nor the Vice-President shall succeed himself in his respective office. This prohibition shall not apply to a person acting as President under the provisions of Sec. 2.2 of this Article.

Sec. 3. *Nomination and election of President, Vice-President, and Treasurer:*

3.1. At the regular meeting of the Board of Directors in January, a Nominating Committee consisting of the Directors representing the various Sections shall meet under the chairmanship of the President. The committee shall nominate one, and may nominate a second, candidate for each of the offices of President, Vice-President, and Treasurer. The candidates must be Active Members, must be past or present members of the Board of Directors, and must signify willingness to accept nomination. The Committee shall report its list of nominees to the Board before the close of the January meeting, and the list shall be mailed to the membership before February 1 of that year.

3.2. At any time prior to noon on March 1, additional candidates meeting the qualifications set forth in Sec. 3.1 of this Article may be nominated by a petition signed by at least 50 Active Members and filed with the Executive Secretary.

3.3. If only one candidate has been nominated for an office by noon on March 1, he shall be considered elected. When more than one candidate has been nominated for an office, the Executive Secretary shall prepare a letter ballot listing the nominees in alphabetical order, with their place of residence, and indicating those named by the Nominating Committee. The ballot shall be mailed to each Active Member prior to April 1.

3.4. Every Active Member shall be entitled to vote for one candidate for each of the offices appearing on the ballot. The voter shall seal his marked ballot in a special envelope provided, enclose the latter in a larger envelope bearing his signature, and mail it to the Executive Secretary.

3.5. The Executive Secretary, together with two or more Tellers appointed by the President, shall open and count all valid ballots at a time and place fixed by the President. The time shall be not less than three nor more than twelve days before the new term of office begins. No ballot received later than noon of the twelfth day shall be counted.

3.6. The Tellers shall certify their count to the President in writing, and he shall announce the results at the annual convention. The candidate with the highest number of votes among all the candidates for a particular office shall be declared elected. If there is a tie, the President shall order a ballot taken among the Active Members present at the convention to break it.

3.7. If the balloting takes place in a year in which the annual convention is not to be held or will not begin before August 15, the President shall, before July 1, announce the results of the Tellers' count to the Executive Committee, which shall declare the candidates with a plurality elected. In the event of a tie, the President shall call a meeting of the Board of Directors during July, at which time they shall vote to break the tie.

Sec. 4. *Appointment of Executive Secretary.* The Executive Secretary shall be appointed by the Executive Committee, subject to confirmation by the Board of Directors.

(*Constitution*)

ARTICLE V

Amendments

Sec. 1. *Initiation:*

1.1. Amendments to this Constitution may be proposed by the Board of Directors or by a written petition signed by either (a) ten or more Active Members of each of a majority of the Sections or (b) 250 or more Active Members, regardless of Section. The Executive Secretary shall submit such petitions to the next meeting of the Board scheduled to take place at least 30 days after he receives them.

1.2. The Board shall consider the proposals, and its opinion shall be transmitted to the proposers by the Executive Secretary not later than 21 days after the conclusion of the meeting. The proposers may then withdraw their proposals, accept any change suggested, or insist on the original form, sending their decision to the Executive Secretary not later than 30 days after the date of the Executive Secretary's notice of the Board's action.

Sec. 2. *Discussion at convention.* Proposals, whether initiated by the Board or by petition, shall be mailed by the Executive Secretary to the Active Members not less than 21 days prior to the next annual convention and shall be scheduled for discussion there. If, as a result of such discussion, the proposers then desire to withdraw or modify their proposals, they shall notify the Executive Secretary within 30 days after the close of the convention. He shall thereupon transmit their decision to the Executive Committee for approval. If the Committee approves the proposers' modifications, the proposals shall be submitted as modified to the Active Members in accordance with Sec. 3 of this Article. If the Committee disapproves modification or withdrawal, the original proposals shall be submitted to the Active Members in accordance with Sec. 3.

Sec. 3. *Letter ballot:*

3.1. Not more than 90 days after the close of the convention, the Executive Secretary shall mail to all Active Members a letter ballot on such proposals as have not been withdrawn. On the written request of ten or more Active Members, the letter ballot shall be accompanied by a statement giving arguments for and against a proposal. This statement shall be edited by a committee appointed by the Board of Directors, consisting of an equal number of members favoring and members opposing the proposal.

3.2. The letter ballot shall be returnable to the Executive Secretary not later than 120 days after the close of the convention. Three Tellers appointed by the Board of Directors shall forthwith count the ballots and report the results to the Executive Secretary, who shall, in turn, inform the Board.

Sec. 4. *Adoption:*

4.1. Affirmation by a two-thirds majority of all valid ballots shall be necessary for the amendment of any part of this Constitution.

4.2. The amendments passed shall take effect at the beginning of the next calendar year, except that changes affecting the tenure of office of an elective officer (Art. IV, Sec. 2.1) shall not take effect until the next annual convention.

BYLAWS

ARTICLE I

Membership Qualifications, Classifications, and Privileges

Sec. 1. *Qualifications:*

1.1. All members shall have a recognizable interest in the furtherance of the objects of the Association as set forth in Art. II of the Constitution.

1.2. No member shall carry on a business or profession other than in a fully ethical manner and in conformity with generally accepted principles of conduct.

1.3. Every member not specifically exempted shall pay the dues and fees established for his class of membership in accordance with Art. III of these Bylaws.

Sec. 2. *Classifications and privileges.* The membership of the Association shall consist of:

a. Active Members—individuals such as water utility personnel, municipal officials, public health workers, engineers, scientists, educators, consultants, and others who meet the qualifications in Sec. 1 above.

b. Student Members—regularly enrolled college or university students. Student Members shall be entitled to all the rights and privileges of Active Members except holding office and voting.

c. Corporate Members—organizations engaged in supplying water for public or other use; government agencies; and firms engaged solely in consulting practice. Each Corporate Member shall be entitled to name a representative, who shall have all the rights and privileges of an Active Member. A representative may be changed on written notice to the Executive Secretary.

d. Associate Members—firms or corporations engaged in the manufacturing or furnishing of products or services in connection with water supply. Each Associate Member shall be entitled to name a representative, who shall have all the rights and privileges of an Active Member except holding office and voting.

e. Life Members—individuals who have continuously for 30 years been Active Members or accredited representatives of Corporate Members, or a combination thereof. The Board of Directors may, at its discretion, confer Life Membership upon other individuals whose affiliation with the Association, in one form or another, has totaled 30 years. A Life Member shall have all the rights and privileges of an Active Member and shall be exempt from paying dues, but the granting of Life Membership to the representative of a Corporate Member shall not relieve the latter from the payment of dues.

f. Honorary Members—individuals whose knowledge and accomplishments in the field of water supply entitle them to special recognition. An Honorary Member shall have all the rights and privileges of an Active Member and shall be exempt from paying dues.

Sec. 3. *Municipal Service Subscribers:*

3.1. Municipal water departments, boards, or commissions desiring to receive all the publications and bulletins sent to Active Members may purchase a Municipal Service Subscription.

3.2. A Municipal Service Subscriber shall be entitled to all the rights and privileges of a Corporate Member. Whenever the term "Corporate Member" appears in these Bylaws, it shall be understood to include Municipal Service Subscribers, unless otherwise specified.

(*Bylaws*)

ARTICLE II

Admission and Expulsion of Members

Sec. 1. *Application.* Application for membership shall be made to the Executive Secretary on a form provided by the Association, shall include an adequate statement of the applicant's qualifications for membership, and shall describe precisely the nature of the professional or business activity in which the applicant is engaged. In addition, an applicant for Associate Membership shall be required to furnish specific information concerning the ownership, corporate structure, and financial standing of the applicant, together with the names of customers from whose experience the applicant's reputation in the water supply field can be ascertained.

Sec. 2. *Endorsement:*

2.1 Applications for Active or Student Membership shall, whenever possible, be filed with the endorsement of a member of the Association. Unendorsed applications shall be referred by the Executive Secretary, for endorsement, to a member residing in the area where the applicant is located. If there are no members in that area, the Executive Secretary shall require the applicant to furnish such evidence of his professional standing and activity as will enable the Executive Secretary to endorse the application.

2.2. Applications for Corporate Membership shall be endorsed by the Executive Secretary after he has satisfied himself that the applicant meets the requisite qualifications.

2.3. Applications for Associate Membership, together with the supplementary information prescribed in Sec. 1 of this Article, shall be referred to the Executive Committee of the Board of Directors for endorsement or rejection. The Executive Committee shall, with the Board's concurrence, establish such criteria as it deems necessary for determining whether applicants for Associate Membership meet the requisite qualifications.

Sec. 3. *Admission:*

3.1. There shall be a Committee on Admissions, which shall consist of three members of the Board of Directors appointed by the President with the consent of the Board.

3.2. The Executive Secretary shall notify the Board of Directors of applications endorsed as prescribed in Sec. 2 above. The Board member representing the Section to which an applicant

will be assigned if accepted shall inform himself as fully as reasonably possible concerning the business practices and general reputation of the applicant.

3.3. If any Board member desires an application to be reserved for action by the Board, he shall so advise the Executive Secretary; otherwise the application shall be referred to the Committee on Admissions.

3.4. Approval of applications referred to the Board for action at any meeting shall require a majority vote of those present. Approval of applications referred to the Committee on Admissions shall require a unanimous vote of that Committee.

3.5. Election to membership shall not become effective until the annual dues of the applicant have been paid.

Sec. 4. *Election of Honorary Members:*

4.1. A Committee on Honorary Membership, consisting of the President and the first and second most recent living Past-Presidents, the latter serving as chairman, shall, on its own initiative or at the request of 25 Active Members, consider the qualifications of individuals for Honorary Membership. The Committee shall report its nominees to the Board of Directors at any regular meeting thereof. The Board may vote on nominees for Honorary Membership only at its January meeting. Election shall be by secret ballot and shall not carry if more than one negative vote is cast.

4.2. No election to Honorary Membership shall be made if it would cause the total number of such members to exceed 1/150 of the total number of Active Members. The maximum number of Honorary Members who may be elected in any single year shall be four, plus one for each 1,000 Active Members in excess of 10,000.

Sec. 5. *Resignation.* Any member in good standing may resign from membership by giving written notice to the Executive Secretary. Such action shall not entitle a member to a refund of dues or relieve him of the obligation to pay any charges he may have incurred during the period of membership.

Sec. 6. *Suspension and expulsion:*

6.1. A member who fails to pay the applicable dues and fees prescribed in Art. III may be suspended or removed from the rolls as provided in Sec. 4 thereof.

6.2. Any member ceasing to meet the qualifications set forth in Sec. 1.1 and 1.2 of Art. I, or the criteria established by the Executive Committee in accordance with Sec. 2.3 of Art. II, or for other good cause, may be expelled from the Association by a three-fourths vote of the Board of Directors, provided such member has been given a written statement of charges preferred and has been accorded the opportunity of a hearing before the Board.

(*Bylaws*)

ARTICLE III

Dues and Fees

Sec. 1. *Payment of annual dues:*

1.1. Each Active, Corporate, Associate, and Student Member shall pay annual dues in the amount currently in effect for his respective class of membership. Payment shall be due on the

first day of each annual period, and the Executive Secretary shall, prior to that day, notify each member of the amount due for the ensuing year.

1.2. Municipal Service Subscribers shall pay an annual fee equal to the annual dues of Corporate Members and shall receive the publications and services of the Association on the same basis as Corporate Members.

1.3. Changes in the amount of annual dues required for the various membership classes may be made by the Board of Directors in the manner prescribed in Art. IX for amendment of these Bylaws, provided that such action is completed not less than 90 days prior to the end of the calendar year preceding the effective date of such changes.

Sec. 2. *Remission of dues.* The Board of Directors may, for good cause, temporarily or permanently excuse from the payment of annual dues any member who, because of ill health, advanced age, or other disability, cannot pay such dues, and the Board may remit the whole or part of dues in arrears, or accept in lieu thereof desirable additions to the library or collections.

Sec. 3. *Subscriptions included in dues.* Each member's annual dues shall include the cost of a subscription to *Journal American Water Works Association, Willing Water,* and such other periodical publications of the Association as may be approved by the Board of Directors.

Sec. 4. *Arrears:*

4.1. A member whose dues are in arrears for three months shall be suspended, all rights and privileges of membership being withheld from him until his dues are paid. Members in arrears for one year shall be automatically removed from the rolls by the Executive Secretary.

4.2. Members who fail to pay charges for materials, services, or advertising ordered on their behalf from the Association may, on 30 days' notice, be suspended by the Executive Secretary until the account is paid.

4.3. No member who has been removed from the rolls shall be reinstated until he has paid all charges outstanding against him.

(*Bylaws*)

ARTICLE IV

Duties of Officers

Sec. 1. *President.* The President shall preside at all conventions of the Association and all meetings of the Board of Directors. The President shall be, ex officio, a member of such committees as he desires. He shall perform such other duties as may be specified elsewhere in these Bylaws or assigned by the Board of Directors.

Sec. 2. *Vice-President.* The Vice-President shall preside at conventions and Board of Directors meetings in the absence of the President. If the Vice-President is unable to preside, the President shall designate a presiding officer to act in his stead. The Vice-President shall be, ex officio, a member of such committees as he desires. He shall perform such other duties as may be specified elsewhere in these Bylaws or assigned by the Board of Directors.

Sec. 3. *Treasurer:*

3.1. The Treasurer shall have supervision of the funds of the Association.

He shall, with the advice and consent of a Finance Committee appointed by the Board of Directors, temporarily invest those funds to the extent warranted by the Association's cash position. He shall act as consultant to the Executive Secretary in all fiscal matters of the Association. He shall make such reports to the Board of Directors as may be appropriate in the discharge of these responsibilities. He shall perform such other duties as may be specified elsewhere in these Bylaws or assigned by the Board.

3.2. The Treasurer shall be bonded, at the expense of the Association, in an amount determined by the Board of Directors.

Sec. 4. *Executive Secretary:*

4.1. The Executive Secretary shall direct all staff activities. Appointments to the staff and dismissals therefrom shall be made by him with the advice of the President.

4.2. The Executive Secretary shall:

a. Prepare the agenda for, attend all meetings of, and record the proceedings of the Board of Directors and the Executive Committee.

b. Taking counsel with the chairman of the Technical Program Committee, prepare and publish the program of, and be present at, the conventions of the Association.

c. Be responsible for the content and distribution of the periodical and occasional publications of the Association.

d. Act as secretary of the Committee on Standardization, the Committee on Professional and Administrative Practice, the Technical Program Committee, the Committee on Research, and the Committee on Education.

e. Present for approval by the Board of Directors an annual budget prepared with the advice of the Treasurer and the Finance Committee.

f. See that all moneys due the Association are collected and promptly deposited to its credit, and that the Association incurs no indebtedness greater than its liquid assets; pay all proper charges against the Association; and submit to the Treasurer a monthly financial report, in such detail as he may request, with a summary thereof to each member of the Board of Directors.

g. Have charge of the books and records of the Association and make them available for audit, annually or as otherwise specified by the Board of Directors, by certified public accountants appointed by the Board.

h. Make such reports to the Board of Directors as are specified in these Bylaws, and such additional reports as he deems necessary or the Board may call for.

i. Perform such other duties as may be specified elsewhere in these Bylaws or assigned by the Board of Directors.

4.3. *Bonding.* The Executive Secretary shall be bonded, at the expense of the Association, in an amount determined by the Board of Directors.

(*Bylaws*)

ARTICLE V

Conventions and Board Meetings

Sec. 1. *Conventions:*

1.1. The annual convention of the Association shall be held at a time and place selected by the Board of Directors. Additional conventions may be held at such times and places as the Board directs.

1.2. Members and guests attending any convention shall each pay a registration fee, the amount to be determined by the Executive Secretary, with the advice of the Treasurer.

Sec. 2. *Board meetings:*

2.1. The Board of Directors shall hold two meetings at the time of the annual convention: one on the first day or the day preceding; the other on the last day or the day following.

2.2. The meeting of the Board of Directors in January shall convene no later than January 29.

2.3. In a year when the annual convention will not begin before August 15, the Board shall meet during July at the call of the President. It shall transact such business as is appropriate under the circumstances, including the appointment of committees whose term of duty would normally date from the annual convention.

2.4. The Executive Secretary shall notify all Board members at least ten days in advance of a meeting.

Sec. 3. *Section meetings.* Meetings of the Sections shall be held as prescribed by the bylaws of the Sections.

Sec. 4. *Rules.* All conventions and meetings shall be conducted according to the latest edition of "Robert's Rules of Order Revised." Except as otherwise provided in these Bylaws, all questions before the Board of Directors shall be decided by a majority vote. No Board member shall have more than one vote.

(*Bylaws*)

ARTICLE VI

Executive Committee

Sec. 1. *Appointment.* The Executive Committee (Constitution, Art. III, Sec. 5) shall be appointed at the meeting of the Board of Directors held (as prescribed in Sec. 2 of Art. V) at the close of the annual convention or in July.

Sec. 2. *Officers.* The President shall act as chairman and the Executive Secretary as secretary of the Committee. In the President's absence, the Committee shall choose a temporary chairman from its members.

Sec. 3. *Meetings.* The Committee shall meet at the call of the President or any four of its members.

Sec. 4. *Powers.* Between meetings of the Board of Directors, the Executive Committee shall have and exercise all of the authority of the Board in the

management of the Association, but the Committee shall not act for the Board under the provisions of Sec. 6.2 of Art. II, nor shall it take any action that will result in a change in the number of directors, nor shall the Committee's power to amend these Bylaws (Art. IX, Sec. 2) apply to this Article.

(*Bylaws*)

ARTICLE VII

Standing Committees

Sec. 1. *General Policy Committee:*

1.1. The General Policy Committee shall consist of the President; the four most recent living Past-Presidents; and two representatives of the Water and Sewage Works Manufacturers Association designated by it and acceptable to the AWWA Board of Directors. The chairman of the General Policy Committee shall be the latest living Past-President of AWWA.

1.2. The General Policy Committee shall consider such matters having to do with the general or long-term policy of the Association as are referred to it by the Board of Directors, the Executive Committee, or the President. The General Policy Committee shall submit any recommendations or policy statements formulated by it to the Board for consideration and further action.

Sec. 2. *Committee on Standardization:*

2.1. A Committee on Standardization, consisting of at least five members, shall be appointed by the incoming Board of Directors at the annual convention. The chairman of the Committee shall be, ex officio, a member of the Board.

2.2. Any statement or document which undertakes, in the name of the Association or of any of its Sections or Divisions, to establish a standard for a technical procedure or a material shall be submitted to the Committee on Standardization. The operations of the Committee shall be governed by the Standardization Procedure adopted by the Board of Directors.

Sec. 3. *Committee on Professional and Administrative Practice:*

3.1. A Committee on Professional and Administrative Practice, consisting of at least five members, shall be appointed by the incoming Board of Directors at the annual convention. The chairman of the Committee shall be, ex officio, a member of the Board.

3.2. The Committee shall consider matters of professional and administrative practice referred to it by the Board of Directors, the Executive Committee, or the President. In addition, the Committee on Professional and Administrative Practice shall, on its own initiative, take up such subjects within its province as it deems worthy of attention. The Committee shall submit any recommendations or policy statements formulated by it to the Board for consideration and further action.

Sec. 4. *Technical Program Committee:*

4.1. A Technical Program Committee, consisting of at least five members, including the chairmen of the Divisions, shall be appointed by the incoming Board of Directors at the annual convention. The chairman of the Com-

mittee shall be, ex officio, a member of the Board.

4.2. The Technical Program Committee shall advise and assist the Executive Secretary in preparing the technical program for the annual convention and in carrying out his responsibilities with regard to Association publications.

Sec. 5. *Committee on Research:*

5.1. A Committee on Research shall be appointed by the incoming Board of Directors at the annual convention. The Committee shall consist of: (a) at least five members at large, including a chairman and vice-chairman, and (b) a representative of each Division, designated by the Division from among its officers. The chairman of the Committee shall be, ex officio, a member of the Board.

5.2. The Committee shall consider matters of research in the water supply field referred to it by the Board of Directors, the Executive Committee, or the President. In addition, the Committee on Research shall, on its own initiative, take up such subjects within its province as it deems worthy of attention. The Committee shall submit any recommendation or policy statements formulated by it to the Board for consideration and further action.

Sec. 6. *Committee on Education:*

6.1. A Committee on Education shall be appointed by the incoming Board of Directors at the annual convention. The Committee shall consist of: (a) at least five members at large, including a chairman and vice-chairman; and (b) a representative of each Division, designated by the Division from among its officers. The chairman of the Committee shall be, ex officio, a member of the Board.

6.2. The Committee shall consider matters of education in the water supply field referred to it by the Board of Directors, the Executive Committee, or the President. In addition, the Committee on Education shall, on its own initiative, take up such subjects within its province as it deems worthy of attention. The Committee shall submit any recommendations or policy statements formulated by it to the Board for consideration and further action.

Sec. 7. *Other committees.* In addition to the standing committees established in this Article and elsewhere in these Bylaws, the Board of Directors may appoint such other standing or special committees as it deems necessary to further the objects of the Association.

(*Bylaws*)

ARTICLE VIII

Sections and Divisions

Sec. 1. *Section formation.* The Board of Directors may establish a Section on receipt of a written request signed by at least 40 Active or Corporate Members residing in the territory to be embraced by the Section.

Sec. 2. *Section boundaries.* Section boundaries shall be fixed by the Board of Directors and may be altered by it to meet the needs of members in the area affected. The Section to which an Association member is as-

signed shall be determined, at the option of the member, by the location either of his residence or of his principal business activity, except as provided in Sec. 4 of this Article.

Sec. 3. *Regional branches.* In order to advance the interests of the Association and the water supply industry, the Board of Directors may allow a Section to organize a regional branch in continental North America outside the limits of the United States, provided the branch membership will number at least 40.

Sec. 4. *Diverse residence:*

4.1. A member whose residence is not within the territory of any Section may, upon written request to the Board of Directors, be included in the Section of his choice, with full rights, until such time as the territory of his residence is embraced by another Section.

4.2. A member whose residence and place of business both lie within one Section may apply to the Executive Secretary for permission to participate in the activities of a Section more conveniently located. The Executive Secretary shall transmit the request to the governing body of the latter Section for consideration. If the request is approved, the member shall be eligible to vote in and enjoy all the privileges of both Sections, except that he may not hold office in both simultaneously. Should a change in circumstances remove the reason for dual membership, it may be terminated by the member or his adopted Section.

Sec. 5. *Section allotments:*

5.1. Each Section shall be entitled to an annual allotment from Association funds, based on Active, Student, and Corporate Membership dues and Municipal Service Subscription fees received by the Association through September 30 of the prior calendar year from members of the Section. The amount of the entitlement shall be 20 per cent of the dues and fees so received, but the minimum amount shall be $200. If, however, a Section has not used up all the funds received from previous allotments, and the unspent balance as of November 30 of the prior year is in excess of the current entitlement, then the entitlement shall be reduced by the excess.

5.2. At the regular Board of Directors meeting in January, the Executive Secretary shall submit a report listing the entitlement of each Section computed as above. After the Board has approved the report and the Association budget for the ensuing year, the Executive Secretary shall notify each Section secretary of the amount of his Section's allotment for the year, and shall provide a form for use in applying for the funds. Upon return of the application, properly signed by the Section secretary and endorsed by the Section chairman, the allotment shall be forwarded to the secretary.

5.3. Section officers are not required to apply for the full amount of the allotment to which the Section is entitled if a smaller amount will meet the Section's needs. Conversely, the Board of Directors may increase a Section's allotment for the coming year beyond its entitlement in order to defray the expense of special Section activities which the Board considers of material benefit to the Section and the Association.

5.4. In computing the annual allotment, the dues paid by a member belonging to two Sections simultaneously (under Sec. 4.2 above) shall be credited to the Section of residence unless the governing bodies of the two Sections agree to divide the credit.

Sec. 6. *Authorized use of Section allotments.* Association funds allotted to Sections shall be used only to carry on activities consistent with the Constitution and Bylaws of the Association and the bylaws of the Section. In questions of consistency, the Board of Directors shall be the final judge, and it may, from time to time, issue statements of policy on this subject. In any event, no portion of such funds shall be used to pay: dues or fees in any other association; expenses of any Section officer or member for travel outside the Section territory (except the expenses of a Section director, chairman, or secretary in attending meetings of an authorized regional branch of the Section); fees or expenses of any legislative agent or representative; charges accruing from social functions at Section meetings (except fees of professional speakers up to $50). The costs of social functions—including meals, entertainment, and other items—shall be paid by the Section out of its income from registration fees or sales of tickets for such events.

Sec. 7. *Section assessments:*

7.1. A Section may apply for permission to levy an assessment upon its members, not exceeding 50 per cent of Active Membership dues, in order to increase its funds available for Section uses consistent with Association objects and policies. An application setting forth the purposes of the assessment and approved by the governing body of the Section shall be filed with the Executive Secretary for transmission to the Executive Committee. If the application is approved by the Committee, a letter-ballot vote of the Section membership shall be taken. If the vote is in favor, the application shall be submitted to the Board of Directors for approval.

7.2. When the above requirements have been fulfilled, the Executive Secretary shall, until directed to cease doing so, include the assessment in the dues bills sent to members of the Section. When payment is received, the assessment portion shall be remitted monthly to the Section secretary and entered in his accounts.

7.3. A Section may discontinue an assessment by taking appropriate action at a regular meeting or by letter-ballot vote of its membership. The Section secretary shall notify the Executive Secretary of such discontinuance.

Sec. 8. *Section accounts:*

8.1. Each Section secretary shall close his accounts as of November 30 of each year, and, not later than December 15 of that year, shall submit to the Executive Secretary a certified copy of his accounts, endorsed by the Section chairman. The accounts shall be itemized and shall show opening and closing balances (including cash, bank deposits, and investments) and receipts and disbursements during the report year separately for: (a) AWWA allotment funds; (b) meeting registration and ticket sale funds; and (c) all other funds to which the Section has title, from whatever sources derived. Parts (b) and (c) are intended for record purposes and for the information of the Board of Directors; they shall not be considered in determining the Section's allotment of Association funds unless the Section has requested a special allotment under Sec. 5.3 of this Article.

8.2. The Executive Secretary shall refer the Section accounts to an auditor selected by the Board of Directors. If the auditor reports that the expenditures have not been assigned in accordance with Sec. 8.1 above, or that the

accounts are otherwise not in order, the Board of Directors shall take such action as it deems proper.

Sec. 9. *Association Divisions:*

9.1. At the request of 100 members, the Board of Directors may establish a Division concerned with a particular area of interest in the water supply field. Any member may participate in the activities of as many Divisions as he desires.

9.2. Statements of Division operating expenses shall be approved by the chairman and secretary of the Division before being forwarded to the Executive Secretary for payment. The annual operating expenses of a Division shall not exceed $100 unless the Board of Directors has previously approved a greater expenditure.

Sec. 10. *Section and Division government.* Sections and Divisions shall consist only of Association members in good standing. They shall elect their own officers and committees, and may adopt bylaws or amendments thereto which are not inconsistent with the Constitution and Bylaws of the Association and have the approval of the Board of Directors.

Sec. 11. *Dissolution.* Any Section or Division may be dissolved by the Board of Directors for reasons which it believes to be sufficient.

(*Bylaws*)

ARTICLE IX

Amendments

Sec. 1. *Board action.* The Board of Directors may amend these Bylaws by a two-thirds majority of those voting at any meeting of the Board, provided that a copy of the proposed amendment was mailed by the Executive Secretary to each Board member at least 30 days before the meeting.

Sec. 2. *Executive Committee action.* Subject to the limitations set forth in Sec. 4 of Art. VI, the Executive Committee may amend these Bylaws at any of its meetings by an affirmative vote of five members, provided that a copy of the proposed amendment was mailed by the Executive Secretary to all members of the Board of Directors at least 30 days prior to the Executive Committee meeting and that all comments received from Board members are considered fully before action is taken.

STANDARDIZATION PROCEDURE

Approved by the AWWA Board of Directors on Jun. 9, 1961

Sec. 1—Scope

1.1. This Standardization Procedure shall apply to the following classes of documents issued in the name of AWWA:

1.1.1. *Standards*—documents that may, with appropriate modifications, serve as contract specifications for the purchase of materials or services.

1.1.2. *Handbooks*—compilations of basic data, usually of a design nature, concerning materials or services, which may assist a purchaser to prepare contract specifications.

1.2. Wherever the word "standard" is used below, it shall be understood to include both of the above classes.

Sec. 2—Initiation of Standards

2.1. Proposals or suggestions for the development of new standards shall be transmitted to the Executive Secretary for preliminary evaluation and, if of sufficient merit, forwarded by him to the Chairman of the Committee on Standardization for further study by the committee. The Chairman shall, in his annual report to the Board of Directors, include a summary of proposals so received, together with the committee's recommendations regarding them.

2.2. When the Board of Directors considers the development of a standard to be desirable, the Executive Secretary, in consultation with the Chairman of the Committee on Standardization, shall assign the project to an existing committee or, with Board of Directors approval, appoint one for the purpose. The makeup of all committees charged with the formulation of standards shall be in accordance with the following rules:

2.2.1. Only persons who are members of AWWA or official representatives of Corporate Members, Associate Members, or Municipal Service Subscribers may serve as members of a committee. However, an Associate Member, Corporate Member, or Municipal Service Subscriber may designate a substitute to serve in place of the official representative. Persons who are especially qualified to assist in the work of a committee may be appointed as Consultants to the committee and participate in its activities, but without the right to vote.

2.2.2. Care shall be taken to provide sufficient representation of producers or distributors to insure that a committee shall have adequate facts to formulate a thorough-going, practicable standard, but not less than two-thirds of the committee members shall have no financial or other private interest in the marketing of any material or service governed by the standard.

2.2.3. Interim appointments and removals may be made by the Executive Secretary in consultation with the Chairman of the Committee on Standardization and the chairman of the committee affected, subject to approval by the Board of Directors at its next meeting.

2.3. A committee charged with developing a standard shall first submit, through the Executive Secretary, a statement of its scope for approval by

the Chairman of the Committee on Standardization.

2.4. It shall be the duty of every committee chairman to see that:

2.4.1. The work of his committee is carried on as expeditiously as possible and in accordance with the terms of its statement of scope. In drafting a standard, the committee shall give consideration to such guidance as the Executive Secretary provides.

2.4.2. A record of committee proceedings is kept.

2.4.3. Reports of progress are submitted to the Executive Secretary for transmission to the Chairman of the Committee on Standardization.

2.4.4. The final draft of a proposed standard is approved by majority vote, individually recorded, of the whole committee, and submitted, together with any dissenting comment from the committee members, to the Executive Secretary for transmission to the Chairman of the Committee on Standardization.

Sec. 3—Acceptance of Standards

3.1. When the final draft of a proposed standard prepared by a committee is received in the office of the Executive Secretary, it shall there be reviewed to ascertain that it is consistent with other standards and policies of AWWA.

3.1.1. If acceptable, the proposed standard shall be put into proper editorial form. All editorial revisions shall be submitted to the chairman of the originating committee for approval. The edited standard shall then be transmitted by the Executive Secretary to the Chairman of the Committee on Standardization.

3.1.2. If, in the opinion of the Executive Secretary, changes in the technical content of the proposed standard appear to be desirable, he shall consult with the Chairman of the Committee on Standardization, and their joint recommendation shall be submitted to discussion and vote by members of the originating committee. The Executive Secretary shall transmit a summary of the committee's opinion or the committee's redraft, if any, of the proposed standard, together with his own recommendation, to the Chairman of the Committee on Standardization.

3.2. Approval of a proposed standard by the Committee on Standardization shall require a favorable vote by at least two-thirds of the members of the whole committee. Each negative ballot cast shall be accompanied by a detailed explanation of the reasons therefor. The results of the balloting shall be transmitted to the Executive Secretary.

3.3. Proposed standards approved by the Committee on Standardization shall be submitted by the Chairman to the Board of Directors for action at its next meeting. Proposed standards failing of approval by the Committee on Standardization shall be returned by the Executive Secretary, together with recommendations for revision, to the chairman of the originating committee. The Executive Secretary shall request the chairman to lay the matter before the committee and to report the result to him by a specified date. The Executive Secretary shall transmit the report, with whatever recommendations he may deem proper, to the Chairman of the Committee on Standardization. The Committee on Standardization may thereupon either: (a) by vote as in Sec. 3.2, approve the standard as originally proposed; (b)

by vote as in Sec. 3.2, approve the standard with such amendments as the committee considers appropriate; (c) by a majority of those voting, request the originating committee to restudy the matter; (d) by a majority of those voting, recommend to the Board that the project be abandoned or a new committee appointed.

3.4. Approval of proposed standards submitted to the Board shall require a favorable vote by at least three-fourths of those voting. In the event of disapproval, the Board shall determine what further action is required.

3.5. The effective date of a standard shall be the first of the month following the month of publication in the *Journal AWWA*, unless a later date is fixed by the Board. A standard shall have "Tentative" status for one year from the effective date, after which the "Tentative" designation shall, with the consent of the Committee on Standardization, no longer apply.

Sec. 4—Revision of Standards

4.1. The Executive Secretary shall initiate periodic reviews of all standards in accordance with Sec. 4.2 and 4.3. below. He shall also evaluate suggestions for revisions received from other sources and, if of sufficient merit, forward them to the appropriate committee for study, following the same procedure as for periodic reviews. No committee shall undertake to revise a standard unless specifically directed to do so.

4.2. When five years have elapsed since the last review or extensive revision of a standard, it shall be subjected to review by the originating committee or a successor committee. If revisions are recommended, the procedure set forth in Sec. 3 shall be followed.

4.3. If neither the committee that originated a standard scheduled for review nor a successor committee is in existence, the Chairman of the Committee on Standardization shall place the standard before his own committee for review, or else recommend to the Board of Directors the appointment of a special committee for the purpose. In the latter case, Sec. 2.2 and Sec. 3 shall apply. In the case of standards reviewed directly by the Committee on Standardization, all recommended revisions shall be transmitted to the Executive Secretary for editing before being submitted to the Board by the Chairman.

4.4. Approval of proposed revisions submitted to the Board shall require a favorable vote by at least three-fourths of those voting. A standard so revised shall not retain or revert to "Tentative" status unless a majority of the Board members voting so directs.

4.5. Notice of all revisions approved by the Board shall appear in the *Journal AWWA*. The effective date of a revision shall be the first of the month following the month of publication of notice, unless a later date is fixed by the Board. The changes shall be incorporated in subsequent printings of the standard affected, and a summary of the changes shall, whenever practicable, be included in a prominent place in the standard. When a standard has been reviewed without revision, subsequent printings shall indicate this fact.

4.6. Nothing in the revision procedure herein set forth shall be so construed as to prevent the Executive Secretary from eliminating obvious errors of an editorial nature discovered in an existing standard.

4.7. The procedure for withdrawal of a standard shall be the same as for revision.

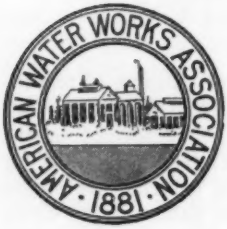
Sec. 5—Emergency Standards

5.1. During a national emergency, the Executive Secretary and the Chairman of the Committee on Standardization may jointly issue supplements to existing standards as conditions require. The Executive Secretary shall notify the members of the Board of Directors and the Committee on Standardization of the action proposed, which shall take effect two weeks after the mailing of such notice.

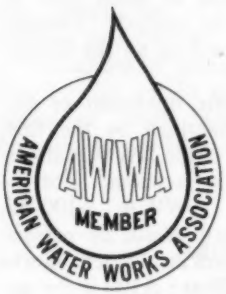
5.2. Emergency supplements shall be published as promptly as possible, in the form deemed most suitable by the Executive Secretary.

5.3. Such standards shall remain in force until withdrawn in the same manner as issued or by action of the Board of Directors.

USE OF AWWA SEAL OR NOTICE OF MEMBERSHIP ON LETTERHEADS OR ADVERTISING MATTER



The Association's corporate seal, pictured at the left, is reserved for the exclusive use of the Association, its Sections, Divisions, Committees, and their officers, in the conduct of official Association business. Its use by anyone else or for any other purpose will not be authorized.



Recognizing that individual and organization members do find occasion to exhibit notice of their membership in AWWA on letterheads and other printed matter, the Association has developed a special AWWA Membership mark (shown at left) for such purposes. This mark or the printed notice "Member American Water Works Association" may be used by any AWWA member in good standing on his letterhead, business card, or other printed matter, provided only that the statement reflect accurately the membership status. In other words, a partnership or corporation must not claim membership on the basis of the Active membership of one of the partners or a member of the staff involved. A partnership, municipality, or corporation that carries a Corporate or Associate membership in its own name may—and, as a matter of fact, is encouraged to—advertise that membership where and when it sees fit.

USE OF AWWA MEMBERSHIP LISTS

A statement adopted by the AWWA Board of Directors on Jan. 23, 1961

AWWA membership lists are the property of the Association and may be used only to carry on Association or Section official business. The Executive Secretary of AWWA may make exceptions in specific cases when he believes the interests of the Association may be furthered thereby. Any person or organization desiring to use the membership list for non-AWWA business should communicate directly with the Executive Secretary, describing the exact nature of the use for which the list is desired.

The requests of Associate Members of AWWA will be given special consideration by the Executive Secretary.

QUOTATION AND REPRINTING RULES

Quotation From American Water Works Association Standards

The following rules are designed to facilitate the use of AWWA standards in the form in which they were issued and for the purposes they were established to serve. Consistent with these aims, the AWWA staff will cooperate fully in efforts to increase the availability of AWWA standards to the water works industry and its suppliers.

1. AWWA standards, handbooks, manuals, and similar documents are copyrighted by the American Water Works Association and may not be reproduced by other organizations. Reprints of such documents may be purchased from AWWA for distribution as separate pamphlets (with the name and address of the distributing organization imprinted on the cover, if desired). AWWA may also, at its discretion, furnish such documents in a form suitable for binding into a publication of another organization, provided:

a. AWWA is informed of the nature and purpose of the publication.

b. It is understood that the furnishing of the AWWA document does not imply permission to reproduce it subsequently.

c. A copy of the publication containing the document is forwarded, when available, to:

Director of Publications
American Water Works Association
2 Park Avenue
New York 16, N.Y.

2. Quotations or extracts of reasonable length taken from AWWA standards, etc., may be authorized at the Association's discretion. Requests for permission should describe the nature and purpose of the publication in which the quotations or extracts are to appear and should provide an exact copy of every quotation or extract. Permission, if granted, will be on the following conditions:

a. Each separate quotation or extract must be identified by the title, number, and date of the AWWA standard from which it is taken. For instance: "From AWWA A100–52, Standard for Deep Wells, by permission of the American Water Works Association." (Note: A100 is the numerical designation; 52 is the date of the edition, 1952.)

b. Each separate quotation or extract must be reproduced exactly and should be checked carefully to ascertain that its sense has not been changed by removal from context. Care should also be taken to insure that accompanying material from other sources is not confused with the material quoted from the AWWA standard.

c. A copy of the publication in which the quotation or extract appears must be forwarded to:

Director of Publications
American Water Works Association
2 Park Avenue
New York 16, N.Y.

Quotations From Journal AWWA

All material published in the JOURNAL AMERICAN WATER WORKS ASSOCIATION is copyrighted by the Association. Brief quotations or extracts may be incorporated without permission in articles or reports whose purpose is the advancement of technical knowledge in the water works field; appropriate reference should be made to the source of such quotations. For extensive quotation (in excess of 100–200 words) or for reproduction of illustrations, permission is required.

Quotations or extracts, regardless of length, may not be used in advertisements or other literature involving commercial products or services without the express written permission of the Association.

Requests for permission should describe the nature and purpose of the publication in which the quotations or extracts are to appear and should provide an exact copy of every quotation or extract. The Association reserves the right to define the conditions under which it will grant permission, and to deny permission at its discretion. Requests should be addressed to:

Director of Publications
American Water Works Association
2 Park Avenue
New York 16, N.Y.

Reprinting Rules—Journal AWWA

Separate reprints of articles published in the JOURNAL AMERICAN WATER WORKS ASSOCIATION are produced exclusively by the Association. Permission will not be given others to make such separate reprints under any circumstances.

Permission to reprint articles from the JOURNAL in recognized periodicals of other publishers may be granted at the Association's discretion, provided that the following conditions are met:

1. The author's written approval of the reprinting is obtained and filed with the Association.

2. The publication requesting reprinting rights agrees:

a. To include a credit line, in the following form, on the first page of the article as reprinted: "Reprinted from *Journal American Water Works Association,* Vol. . . , No. . . (month, year), by permission of the Association."

b. To reprint the article in full (unless omissions are specifically approved by the author) in a single issue, and to make no separate reprints of the article.

c. To forward two copies of the issue in which the reprinted article appears to:

Director of Publications
American Water Works Association
2 Park Avenue
New York 16, N.Y.

3. The Association has, on the basis of the author's approval and the publication's agreement to the above requirements, issued a formal letter of approval for the specific article involved.

FINANCING AWWA SECTION ACTIVITIES

Policy of AWWA

Approved by the Board of Directors on Sep. 11, 1957

1.1. AWWA Sections have available to them funds allotted from the Association; funds derived from the registration fees collected at the time of Section meetings; and funds derived from gifts and interest on investments. Funds allotted from the Association may be used for approved purposes only as described in Article VIII, Sec. 6, of the Bylaws. Registration income and gifts from others than members or representatives of the Water and Sewage Works Manufacturers Association (WSWMA) may be used to defray costs of conducting the Section meeting which are not covered by the authorized uses of the AWWA allotment, and shall also be used to cover all entertainment provided by the Section during the meeting for both the men and the ladies in attendance.

1.2. Funds derived from registration fees or from gifts may be used to defray the cost of legislative activities carried on by representatives of the Section in support of projects or operations which are consistent with the announced general policy of the Association.

1.3. Funds of any nature in possession of the Section shall not be used to pay fees or expenses to nonmember legislative agents.

1.4. Registration fees collected at Section meetings may be uniform for all grades of members and guests or may be upon a graduated basis, designed to provide, through recorded channels, funds to cover the legitimate expenses of conducting the Section meeting. The registration fee shall consist of a basic amount necessary to defray the cost of operating the meeting, plus such amount as is required to pay for special luncheons and/or a banquet held at the time of the Section meeting. The maximum basic registration fee collected from any class of members (except representatives of Associate Members) shall not exceed $10. The charge for special luncheons and the annual banquet shall be added to the basic registration fee.

1.5. Registration fees collected from representatives of Associate Members may be higher than the fees collected from other classes of members. Consulting engineer members shall be charged the same registration fee as Active Members.

1.6. Representatives of a nonmember manufacturing firm shall be charged a registration fee double that charged the representatives of manufacturers who are Associate Members.

1.7. The Water and Sewage Works Manufacturers Association (WSWMA) shall establish its own rulings (approved by AWWA) as to exhibits at Section meetings, *except* that no firm or person shall be allowed to exhibit at any convention or Section meeting unless he is an Associate Member of AWWA.

1.8. It is the policy of WSWMA to fund and conduct a "Club Room" during Section meetings. The committee in charge of the Club Room consists of three representatives of the manufacturers and three representatives of the Section, one of whom is the Secretary of the Section. Such collec-

tion of Club Room funds as is necessary at the time of the Section meeting shall be made by a representative of WSWMA at a location separate from the Section Secretary's registration operations. These funds shall be kept completely separate from the Section Secretary's funds. The time and place of the Club Room shall be agreed upon by the joint committee above described. The funds collected for the Club Room shall be the property of WSWMA and such of these costs as are not covered by the collection of funds at the time of the Section meeting are to be paid by WSWMA.

Policy of WSWMA

The following paragraph from Article XIII, Section 3 of the By-Laws of the Water and Sewage Works Manufacturers Association, as revised on September 15, 1946, is appended for the information of AWWA members:

"Members may not exhibit at conventions or meetings of superintendents or engineers or representatives of water works or of sewage works *not endorsed by the Board of Governors. No member shall contribute to or arrange special forms of entertainment at* any convention or meeting of water works or sewage works representatives. Any such entertainment shall be provided or arranged for by the Association as such and any infraction of this ruling shall be cause for the suspension of the offending member or members."

A further policy statement adopted by its Board of Governors on May 26, 1954, may be obtained from the office of the WSWMA.

SECTION EXPRESSIONS ON POLICY MATTERS

A resolution adopted by the Board of Directors on Jul. 25, 1947

Sections of the Association desiring to express themselves upon matters of public policy, either by a vote of the members in a regular meeting, or by a vote of the Board of Trustees, or executive group of the Section between regular meetings of the Section, shall confine themselves to practices, policies or procedures within the geographic territory of the Section. If the Section wishes to have consideration given to any matter of public policy or procedure, having a regional, national or international interest beyond the territorial limit of the Section, this desire for consideration of or expression of opinion shall be routed through the Director representing the Section to the AWWA Board of Directors; the Board will thereupon give such consideration as it wishes to the subject and adopt whatever expression of Association viewpoint is fitting for the circumstances.

POLICY ON ELIGIBILITY FOR SECTION OFFICES

A statement adopted by the Board of Directors on Jun. 12, 1955

It is the unanimous opinion of this Board that any member otherwise eligible to hold elective office in a Section shall not be disqualified by reason of his occupation.

SECTION AWARD POLICY

The following is a statement of policy on the establishment of awards by AWWA Sections. The policy was recommended by the General Policy Committee and adopted by the Board of Directors of the AWWA, Items 1 to 8 being adopted June 3, 1949, and Items 9 and 10, May 8, 1952.

The AWWA is primarily a professional and technical association whose awards have always been highly prized by their recipients. It is to insure the maintenance of this high award standard within its proper sphere that the items below are listed for consideration by, and the guidance of, those who have the responsibility either for initiating or conferring the awards.

1. Long service in the water works industry, of itself, may be the basis for the individual company, municipality or state to acknowledge the service of a long-time employee.

2. Long service in the water works industry, of itself, is not sufficient basis for the granting of AWWA or Sectional awards.

3. Neither the AWWA nor its Sections should seek to perform the function of the employer in Point 1, above, where long service is the principal reason for recognition.

4. Long-term membership in the Association is a proper subject of recognition for the various Sections to accord their members.

5. If Sections find it desirable to recognize long-term service by an individual to his community coupled with his membership in the Association, it would tend to increase the value of the action if some minimum term of membership were agreed upon as the basis for such recognition. The minimum term should be not less than ten years.

6. It is the committee's opinion that the word "Award" should be reserved for honors involving service or a contribution on the part of the member, and a differing designation (for example, "Citation") used to describe those honors having to do largely with tenure.

7. Outstanding achievement in the water works field is, of course, a proper basis for an award by the AWWA or a Section at any time, regardless of length of service or length of membership.

8. "Outstanding achievement" is a relative term; and to the extent that increasing numbers of annual awards become available, the quality of the service and the value of the award tend to depreciate.

9. The most serious consideration should be given before any Section formalizes any award, honor, prize, citation, or similar plan of recognition. The specifications for making such recognition, including the form such recognition shall take, shall be submitted to the General Policy Committee of the Association. After consideration by that committee, and after approval by the Board of Directors of the Association, the Section may formalize such plan of recognition.

10. The expenses of all Section awards shall be borne by the Section involved.

ADVANCEMENT AWARD RULES

The Advancement Award has been established to recognize outstanding achievements of water utilities in the fields of community relations and professional advancement. The following rules shall govern the conduct of Advancement Award competitions by local Sections:

Eligibility

Eligibility for the AWWA Advancement Award competition is limited to water utilities that: (1) are Corporate Members; (2) are Municipal Service Subscribers; or (3) have a regular employee who is an Active Member.

Time of Entry

Any water utility wishing to enter the Advancement Award competition shall notify the Section Advancement Chairman, in writing, at least one month before the date of the annual Section meeting. The letter of notification must include a summary of the three points outlined in the "Form of Entry" section, below. The entry, with its supporting exhibits, must be delivered to the Section Advancement Chairman before noon of the first day of the Section meeting at which it is to be judged.

Scope of Entry

The entry must cover accomplishments in community relations activities within the eighteen months prior to the Section meeting. The entry may cover an overall community relations program or any one or a combination of activities in such areas as press relations, cooperation with schools, stockholder relations, advertising, speakers' programs, employee relations, or communication.

Form of Entry

Each entry shall include material substantiating the accomplishments claimed, and shall be divided into three parts:

1. A statement of the objective of the community relations project
2. A documented review of the steps taken to obtain the objective
3. A report of the results obtained and progress toward the stated objective.

Supporting Exhibits

The entry should be supported by exhibits, which should be neatly arranged, but need not be elaborate.

All exhibits shall be of mailable size. They may include such items as press releases and clippings, copies of speeches, advertising, mailing pieces, radio and television scripts, local water utility films, and photographs. Entries shall be judged on the basis of actual progress achieved rather than elaborateness of presentation.

Judging of Contest

The Section Advancement Committee shall display all entries throughout the annual Section meeting to promote interchange of workable ideas. Under the direction of the Section Advancement Chairman, all entries shall be reviewed during the meeting and the winner shall be selected by a majority of the Advancement Committee members present, except that, if fewer than three entries are submitted to the Section, no award shall be made that year. The award shall be presented to a representative of the winning utility

by the Section Advancement Chairman at the Section's annual banquet.

Form of Award

The award shall be a statuette of Willing Water inscribed by the Section with the name of the winning utility, which will retain possession of the trophy.

Publication Rights

Submission of the entry shall constitute a granting of publication rights to AWWA, and the Section Advancement Chairman shall send all of the entries to AWWA headquarters immediately after the award is made. If requested in writing, entries will be returned to the utilities.

AWWA SAFETY AWARD PLAN

On Jan. 28, 1957, the Board of Directors of AWWA at its annual winter meeting considered and unanimously approved a Safety Award Plan for water utilities. This action of the Board achieved an objective of the Committee on Safety Practices that had been under consideration for almost 2 years. As Wendell R. LaDue has been, in effect, the AWWA member responsible for the initiation of the award plan as a whole, the Board agreed that the three general AWWA awards should be titled the "Wendell R. LaDue Awards."

The award plan was developed with the purpose of stimulating water utilities to: [1] start safety programs where none existed; and [2] keep already organized and operating safety programs at a high degree of efficiency.

The plan as approved does not permit direct competition between towns. That type of approach was impractical because of the large number of variables that had to be reconciled. Although competition is desirable, the committee learned that it had to develop from within rather than from outside of the utility. In other words, the award system was set up so that a utility could compete with itself. That is much the same as a golfer competing with par rather than with other golfers. Thus, the incentive which competition affords was retained.

The Safety Award Plan is divided into two parts. One relates to the Sections and the second to the parent Association. Awards at the Section level will be given on an annual basis to all utilities that earn them. AWWA awards will also be given annually, but the number will be limited to three.

Award Plan for Sections

The Safety Award Plan for Sections is based on the establishment of three awards: [1] the Award of Honor, [2] the Award of Merit, and [3] the Award of Progress, the first being highest.

The conditions of eligibility for the awards are simple. For example, utilities will annually be eligible for the *Award of Progress* by demonstrating a prescribed percentage reduction in the injury frequency rate when compared with the previous year. Thus, to be eligible for an award, a utility must keep a safety record for at least a year prior to the year for which the

award is won. The reductions required to be eligible for an Award of Progress are: for utilities with less than 10 employees, 50 per cent or more; 10–100 employees, 30 per cent or more; over 100 employees, 20 per cent or more. The variations in percentage reduction were necessitated by the wide range in the number of employees per utility, which varied from one to more than 3,500, and resulted in large variations in exposure to risks.

The *Award of Merit* is an award given only to utilities employing less than 50 people which have experienced no lost-time injuries during the year.

The top award, the *Award of Honor*, is earned by utilities employing 50 or more people which attain an annual injury frequency rate of 10 or less. The award is also to be granted to smaller utilities that have earned the number of consecutive Awards of Merit specified below and have maintained their unblemished record for another consecutive year:

No. of Employees	No. of Awards of Merit
1–9	5
10–19	4
20–29	3
30–39	2
40–49	1

The Award of Merit was interposed between the Award of Progress and the Award of Honor to produce some semblance of equality in earning the top award. It was recognized that, for the small utilities, the attainment of an injury frequency rate of 10 or less would represent no outstanding accomplishment.

The arbitrary injury frequency rate of 10 was chosen as the criterion for an outstanding safety accomplishment because it represents a reduction of 55 per cent from current average injury frequency rates in the industry. The committee believed that, for the present, the attainment of such a reduction was worthy of recognition. Later, if progress in safety proceeds as expected, the award criteria may be adjusted to retain the value of the award.

The three Section awards will consist of 9 × 12-in. certificates properly designated and carrying the names of the Section chairman, Section secretary, and chairman of the Section safety committee.

Award Plan for AWWA

Safety awards are also available at the parent Association level—one per year for each class size of utility. The three class sizes are: Class Size 1—utilities employing less than 10 people; Class Size 2—10–100 people; Class Size 3—more than 100 people. These Wendell R. LaDue Awards will be granted only for outstanding accomplishment in safety during a calendar year. The awardees will be chosen by the AWWA Committee on Safety Practices from information sent to it by the various sections. Only Section awardees will be eligible for the AWWA awards, and only one candidate for an award in each class size may be submitted by a Section. Thus, at present, a maximum of only 33 applications in each class size will need to be reviewed by the committee to choose awardees. The AWWA awards will be plaques suitably inscribed.

AMERICAN WATER WORKS ASSOCIATION

Code of Practice

As one engaged in providing public water supply for the people whom I serve and as a member of the American Water Works Association, I hold to these principles:

1 To the best of my ability I shall conduct all operations under my control in such manner as will, as far as the means made available permit, provide adequate water service, preserve the public health and furnish protection to property.

2 I shall consider that in performing this service I am required at all times to act within the bounds of local, state and national law and within the field of orderly procedure among free men.

3 I shall, therefore, extend my own fund of technical and professional information to the end that the procedures which I advocate are based upon well grounded information.

4 In every legitimate manner, I shall encourage the construction of water works structures, the use of materials, as well as management practices and operating procedures, which are economically sound and in the public interest.

5 I shall at all times discourage exaggerated, unfair or untrue statements concerning any operation or material connected with public water supply. In conformance with this principle, I shall endeavor to assist my associates as well as the public in obtaining a correct understanding of water works operations and materials.

6 I shall not accept any remuneration or benefit from any interested party other than my employer or my client. Neither shall I accept any collateral employment which might in any degree adversely affect my performance of my duties or obligations to my regular employer or client.

7 If I have a financial or personal interest in any invention, apparatus, device or procedure, which may be offered for sale to, or considered for purchase by, my employer or my client, I shall disclose that interest fully and shall participate in no decision related to its purchase or use by that employer or client.

8 I hold to the opinion that honorable competition for advancement and for opportunity to render more responsible service is an essential part of democratic civilization—upon which rests real improvement and progress. But I shall not permit my own ambition for advancement to cause me to act unfairly toward others associated with me.

9 I shall by all legitimate and reasonable means strive to improve the public appreciation of the services rendered by myself and my associates—to the end that employment in the public water supply field is recognized by all as a legitimate and lifetime career for well trained and industrious citizens.

10 I shall not, as an incident related to discussions of rates of pay or conditions of employment, suspend or fail to perform the duties entrusted to me, nor permit water service to fail the citizens who depend on me. I shall, having associated myself with public water supply operations, hold the public interest superior to my personal interests and I shall by my acts and by my leadership see to it that water service is maintained under both normal and emergency conditions.

In short, I understand my obligations to my community and having accepted responsibilities upon which depend public health and safety, I shall not fail. . . . . . .

HONORARY AWARDS

Honorary Membership

Honorary Membership in the American Water Works Association is provided for in the Bylaws, Article I, Sec. 2f. The method of the election of Honorary Members is stated by the Bylaws, Article II, Sec. 4. The presentation of Honorary Memberships usually takes place during the Annual Convention of the Association. The present Honorary Members of the Association, with the years of their election, are:

Thomas Lampkin Amiss	1949
Louis Evans Ayres	1955
John Robert Baylis	1946
Albert Edward Berry	1957
Alvin Percy Black	1956
William Whitlock Brush	1937
George Cyrus Bunker	1943
James Morton Caird	1942
Charles Herbert Capen	1957
Edward Sherman Chase	1959
Charles Raymond Cox	1951
Henry Francis Cronin	1956
Morrison Benjamin Cunningham	1958
Wilfred Willis DeBerard	1942
Ray Lyle Derby	1961
Ross Leonard Dobbin	1937
Otto Elis Eckert	1961
Raymond Johns Faust	1960
Herbert Branch Foote	1955
Fred Guyon Gordon	1958
Attmore E. Griffin	1961
Frank Eugene Hale	1944
Louis Richard Howson	1948
William Whitehead Hurlbut	1943
Charles Gilman Hyde	1939
Morris Shelley Jones	1959
Harry Edward Jordan	1939
Samuel Logan Kerr	1957
Willibald Alphons Kunigk	1957
Wendell Richard LaDue	1953
Beekman Cox Little	1939
Fred Merryfield	1961
Samuel Brooks Morris	1951
Ben Stogden Morrow	1954
Howard Scott Morse	1952
John Huey Murdoch Jr.	1950
Samuel Frank Newkirk Jr.	1954
Reeves Newsom	1953
William John Orchard	1937
Malcolm Pirnie	1947
Sheppard Tappen Powell	1951
George Wesley Pracy	1950
Thomas Julian Skinker	1956
Marsden Churchill Smith	1959
Edward Roy Stapley	1960
Leonard Newton Thompson	1954
Nathan Thomas Veatch	1952
Paul Weir	1960
Thomas Hollis Wiggin	1944
Abel Wolman	1948

The Harry E. Jordan Achievement Award

The Harry E. Jordan Achievement Award was established by the Association in 1951 to recognize, as circumstances warrant, distinguished public service by a member of the Association outside the line of duty. The award was named for the Association's secretary at that time in tribute to the service he had rendered from the time he took office in 1937. Nominations for the award may be made by any member and are transmitted by the Executive Secretary to the General Policy Committee for consideration.

Since the award was established, it has been conferred upon Abel Wolman in 1952 and William John Orchard in 1956.

The John M. Diven Memorial Medal

The John M. Diven medal was established by the Association in 1925 in memory of John M. Diven, a water works superintendent of many years' experience who served as the Association's President in 1892, Vice-President 1887–89, Treasurer 1890–91 and 1903–13, Secretary 1890–91 and 1903–23, and Editor 1914–16.

The award is made each year to the member who has rendered the most outstanding service to the Association during the year, as determined by a committee appointed to submit a report which is subject to ratification by the Board of Directors. The medal is a bronze plaque of Mr. Diven.

George Warren Fuller..... 1926
Arthur Ellsworth Gorman..... 1927
Willard Samuel Cramer..... 1928
James Edwin Gibson..... 1929
Ross Leonard Dobbin..... 1930
Malcolm Pirnie..... 1931
William Whitlock Brush..... 1932
Samuel Brooks Morris..... 1933
Leonard Percy Wood..... 1934
Linn Harrison Enslow..... 1935
Harry Edward Jordan..... 1936
Abel Wolman..... 1937
William Curtis Mabee..... 1938
Hallett Francis Smith..... 1939
William Victor Weir..... 1940
William Whitehead Hurlbut..... 1941
Samuel Frank Newkirk Jr..... 1942
Earl Devendorf..... 1943
Louis Richard Howson..... 1944
No Award..... 1945
James Clarke Harding..... 1946
Ellsworth Lincoln Filby..... 1947
Asbury Clinton Decker..... 1948
Harry Andrew Faber..... 1949
Joseph Philip Schwada..... 1950
Wendell Richard LaDue..... 1951
Ernest W. Whitlock..... 1952
James E. Kerslake..... 1953
William John Orchard..... 1954
Alvin Percy Black..... 1955
Fred Guyon Gordon..... 1956
John Huey Murdoch Jr..... 1957
Ray Lyle Derby..... 1958
Fred Merryfield..... 1959
Edward Shaw Cole..... 1960
Lewis Spann Finch..... 1961

The AWWA Publications Award

The AWWA Publications Award is made annually to the member whose paper, published by the Association, represents the most notable contribution to the science or practice of water works development. The selection is made by a committee, appointed for the purpose, which submits a report subject to Board ratification. (This award was formerly called the Goodell Prize.)

John Robert Baylis..... 1932
Charles Herbert Spaulding..... 1933
Willard Townshend Chevalier..... 1934
Frank Eugene Hale..... 1935
Mathew Michael Braidech..... 1936
Laurance Edward Goit, Harry Hayes } Jointly..... 1937
Vance Christopher Lischer..... 1938
Albert George Fiedler, David Grosh Thompson } Jointly..... 1939
Melvin Lorenius Enger, Thomas Hollis Wiggin } Jointly..... 1940
Paul Weir..... 1941
Ray Freeman Goudey..... 1942
Wilfred Francis Langelier, Harvey Fred Ludwig } Jointly. 1943

Noel Stillwell Chamberlin, John Richard Glass — Jointly. 1944
Hans Victor Pedersen 1945
Carl Martin Riedel 1946
Louis Richard Howson 1947
Melvin Pross Hatcher 1948
Laurie Moyes Leedom 1949
Special Committee on AWWA Policy re Fluoridation of Public Water Supplies (A. P. Black, *Chairman;* A. E. Berry; H. A. Faber; R. J. Faust; W. V. Weir; H. T. Dean, *Consultant;* and L. H. Enslow, *ex officio*) .. 1950
Malcolm Strong McIlroy 1951
Joseph M. Sanchis, John C. Merrell Jr. — Jointly 1952
Edward W. Moore 1953
Michael J. Taras 1954
Paul D. Haney 1955
H. S. Swanson, H. J. Chapton, C. L. King, E. D. Nelson — Jointly 1956
Thurston E. Larson 1957
Herbert O. Hartung 1958
Louis R. Howson 1959
James G. Carns Jr. 1960
Claud R. Erickson 1961

Division Awards

Established in 1954, these awards, in the form of certificates, may be granted annually at the discretion of each of the four Association Divisions to the author of the best paper in its respective field of interest published by the Association. Eligibility for the awards is limited to those who were members of the Association at the time their papers were presented at an Association meeting or, if not so presented, at the time their papers were offered for publication, but nonmember coauthors of award-winning papers will be given appropriate certificates of commendation.

Distribution Division

E. O. Potthoff 1955
Leslie Paul 1956
Jack Whiting MacKay 1957
Jerome B. Wolff 1958
Martin E. Flentje, Robert J. Sweitzer — Jointly 1959
Murray B. McPherson, Joseph V. Radziul — Jointly 1960
Robert F. McCauley 1961

Purification Division

Paul D. Haney 1955
Arnold Kenneth Cherry 1956
John Robert Baylis 1957
Graham Walton 1958
Dwight F. Metzler, Russell L. Culp, Howard A. Stoltenberg, Richard L. Woodward, Graham Walton, Charles M. Palmer, Francis M. Middleton — (Jointly) .. 1959
A. P. Black, Fred A. Eidsness — Jointly 1960
Jonathan L. Tuepker, Herbert O. Hartung — Jointly 1961

Management Division

John H. Murdoch Jr. 1955
Abel Wolman 1956
Louis Richard Howson 1957
Hyman H. Gerstein 1958
Alexander C. Rener 1959
John W. McFarland 1960
William R. Seeger 1961

Resources Division

H. E. Hudson Jr. 1955
Finley Burnap Laverty 1956
Warren J. Kaufman, Gerald T. Orlob — Jointly 1957
Harvey O. Banks 1958
Richard Hazen 1959
Ernest F. Gloyna, W. R. Drynan — Jointly 1960
Louis Koenig 1961

The Nicholas S. Hill Jr. Cup

The Nicholas S. Hill Jr. Cup is an award which was established by Past-President Nicholas S. Hill Jr. during his term of office in 1915–16. It is awarded at each Annual Convention to that Local Section of the Association which has made the largest percentage gain in membership during the year.

Under the original terms of the award the cup was to become the permanent possession of the Section which first won it for three successive years. This was first accomplished by the Minnesota Section, but due to the unusual conditions then prevailing as a result of the war the Section returned the cup for continued competition. When the North Carolina Section won the cup for the third successive year in 1924 the Section returned it to the Association with the stipulation that no Section should again win it permanently. The names of the winning Sections are engraved upon the cup.

CANADIAN SECTION..... 1916
MINNESOTA SECTION..... 1917–18–19
CANADIAN SECTION..... 1920
CENTRAL STATES SECTION..... 1921
NORTH CAROLINA SECTION..... 1922–23–24
CALIFORNIA SECTION..... 1925–26
FLORIDA SECTION..... 1927–28
PACIFIC NORTHWEST SECTION..... 1929
SOUTHEASTERN SECTION..... 1930
PACIFIC NORTHWEST SECTION..... 1931
CALIFORNIA SECTION..... 1932
MONTANA SECTION..... 1933
CANADIAN SECTION..... 1934
VIRGINIA SECTION..... 1935
ROCKY MOUNTAIN SECTION..... 1936
INDIANA SECTION..... 1937
MICHIGAN SECTION..... 1938
WEST VIRGINIA SECTION..... 1939
SOUTHWEST SECTION..... 1940
PACIFIC NORTHWEST SECTION..... 1941
NORTH CAROLINA SECTION..... 1942
FLORIDA SECTION..... 1943
MISSOURI VALLEY SECTION..... 1944
SOUTHWEST SECTION..... 1945
KANSAS SECTION..... 1946
FLORIDA SECTION..... 1947
SOUTHWEST SECTION..... 1948
ARIZONA SECTION..... 1949
KANSAS SECTION..... 1950–51
NEBRASKA SECTION..... 1952
SOUTHWEST SECTION..... 1953
PACIFIC NORTHWEST SECTION..... 1954
SOUTHWEST SECTION..... 1955
INDIANA SECTION..... 1956
IOWA SECTION..... 1957
CALIFORNIA SECTION..... 1958
INTERMOUNTAIN SECTION..... 1959
WISCONSIN SECTION..... 1960

The Old Oaken Bucket

The Old Oaken Bucket is a symbolic award which was established in 1939. It is awarded at each annual convention to that Section of the Association which has the largest membership. The trophy is a veritable antique from an old New England farmstead and is particularly appropriate as a water works trophy because of its rarity.

The award has been won by the CALIFORNIA SECTION every year from 1939 through 1960.

The Franklin Henshaw Cup

At each annual conference this cup, a gift of Franklin Henshaw, is awarded to that Section which has shown the greatest improvement in attendance at its annual meeting, as measured by a comparison of the total (men's and women's) registration at its meeting with the highest total registration at any of its previous annual meetings.

Montana Section	1935–36
Indiana Section	1937
Pacific Northwest Section	1938
North Carolina Section	1939
Wisconsin Section	1940
Pacific Northwest Section	1941
Minnesota Section	1942–43
No Award	1944
Wisconsin Section	1945
Cuban Section	1946
Ohio Section	1947
Cuban Section	1948
Arizona Section	1949
Canadian Section	1950
Cuban Section	1951–52
Pacific Northwest Section	1953
Alabama-Mississippi Section	1954
Cuban Section	1955–56
Pacific Northwest Section	1957–58
Cuban Section	1959
Rocky Mountain Section	1960

The George Warren Fuller Memorial Awards

These awards were established in 1937, and are given each year to members of the Association, designated by the Sections, for their distinguished service in the water supply field and in commemoration of the sound engineering skill, the brilliant diplomatic talent, and the constructive leadership of men in the Association which characterized the life of George Warren Fuller—one of America's most eminent engineers.

Each section, each year, *may* designate one of its members to receive a Fuller Award. Such designation is presumed to recognize publicly the contribution toward advancement of water works practice the individual has made within the particular Section selecting him for the award. If two members have joined in a common project which the Section wishes to recognize, both participants may be jointly designated for the award.

These awards are in the form of an engraved certificate signed by the President and Secretary of the Association.

In 1942 the Fuller Awardees formed the "George Warren Fuller Award Society" which gathers each year in a breakfast meeting during the annual convention. The first chairman of this group was Wendell R. LaDue. The 1960–61 chairman is John G. Copley, and the secretary is P. S. Wilson.

The Wendell R. LaDue Safety Awards

The LaDue Awards are granted to water utilities for outstanding accomplishment in the field of safety during a calendar year. For award purposes, utilities are classified into three groups, according to number of employees (Class 1, less than 10; Class 2, 10–100; Class 3, more than 100), and competition is restricted to utilities within each class.

Class 1

JERSEY SHORE [PA.] WATER COMPANY 1959
KNOXVILLE [TENN.] SUBURBAN UTILITY DISTRICT 1960
STILLWATER [MINN.] BOARD OF WATER COMMISSIONERS 1961

Class 2

DULUTH [MINN.] WATER DIVISION... 1958
MONONGAHELA VALLEY [PA.] WATER CORPORATION 1959
BROOKLINE [MASS.] WATER DEPARTMENT 1960
SAN DIMAS–CHARTER OAK DOMESTIC WATER COMPANY..... 1961

Class 3

EAST BAY MUNICIPAL UTILITY DISTRICT [OAKLAND, CALIF.]..... 1958
SAN DIEGO [CALIF.] WATER DEPARTMENT 1959
KNOXVILLE [TENN.] BUREAU OF WATER..... 1960
PACIFIC GAS AND ELECTRIC COMPANY WATER SYSTEMS..... 1961

AWWA Advancement Award

The Advancement Award is made annually to a water utility in recognition of outstanding achievement in the fields of community relations and professional advancement. The awardee is selected at the annual conference from among the winning entries in the local Section competitions held during the preceding year.

Instituted in 1961, the first awardee was the GRIFFIN (GA.) WATER DEPARTMENT.

The Harry E. Jordan Scholarship Award

The Water and Sewage Works Manufacturers Association at its meeting in Seattle on May 26, 1954, formally established an education aid fund of $1,500 annually for the support of the Harry E. Jordan Scholarship. The awardee is selected by a committee appointed by the President of AWWA at the post-convention meeting of the Board of Directors each year. Eligibility of candidates is restricted each year to one of four regions in the United States, its territories, Canada, and Cuba, broadly described as follows: Midwest, Far West, Northeast, and Southeast.

PAUL A. KUHN..... 1955
MARVIN ROBERT LINDORF..... 1956
HERBERT H. HASSIS..... 1957
WILBERT H. SCHLIMMEYER (co-awardee) 1957
JAMES D. GOFF..... 1958
JOHN J. GRIMMER..... 1959
JACK D. SMITH..... 1960
No award..... 1961

CONVENTIONS AND PAST-PRESIDENTS

The President's one-year term of office ends on the last day of the convention

	Convention Place & Time	President
1	St. Louis, Mo. 3/29–31/1881	*John T. Foster, Chicago, Ill.
2	Columbus, Ohio 3/14–16/1882	*John T. Foster, Chicago, Ill.
3	Buffalo, N.Y. 5/15–17/1883	*John T. Foster, Chicago, Ill.
4	Cincinnati, Ohio 4/15–17/1884	*John G. Briggs, Terre Haute, Ind.
5	Boston, Mass. 4/21–23/1885	*L. H. Gardner, New Orleans, La.
6	Denver, Colo. 6/23–25/1886	*Peter Milne Jr., Brooklyn, N.Y.
7	Minneapolis, Minn. 7/13–15/1887	*B. F. Jones, Kansas City, Mo.
8	Cleveland, Ohio 4/17–19/1888	*J. T. Fanning, Minneapolis, Minn.
9	Louisville, Ky. 4/16–18/1889	*A. N. Denman, Des Moines, Iowa
10	Chicago, Ill. 5/20–24/1890	*John H. Decker, Salina, Kan.
11	Philadelphia, Pa. 5/14–17/1891	*William Benedict Bull, Quincy, Ill.
12	New York, N.Y. 5/17–19/1892	*John M. Diven, Elmira, N.Y.
13	Milwaukee, Wis. 9/ 5–9/1893	*G. H. Benzenberg, Milwaukee, Wis.
14	Minneapolis, Minn. 8/21–23/1894	*James Peter Donahue, Davenport, Iowa
15	Atlanta, Ga. 5/28–30/1895	*William Ryle, Paterson, N.J.
16	Indianapolis, Ind. 5/26–28/1896	*William G. Richards, Atlanta, Ga.
17	Denver, Colo. 6/ 8–10/1897	*F. A. W. Davis, Indianapolis, Ind.
18	Buffalo, N.Y. 6/14–18/1898	*John Caulfield, St. Paul, Minn.
19	Columbus, Ohio 5/16–19/1899	*Joseph A. Bond, Wilmington, Del.
20	Richmond, Va. 5/15–18/1900	*R. M. Clayton, Atlanta, Ga.
21	New York, N.Y. 6/17–22/1901	*Charles E. Bolling, Richmond, Va.
22	Chicago, Ill. 6/10–13/1902	*William R. Hill, New York, N.Y.
23	Detroit, Mich. 6/23–26/1903	*Charles H. Campbell, Charlotte, N.C.
24	St. Louis, Mo. 6/ 6–11/1904	*L. N. Case, Duluth, Minn.
25	West Baden, Ind. 5/ 9–12/1905	*Morris R. Sherrerd, Newark, N.J.
26	Boston, Mass. 6/26–30/1906	*Benjamin C. Adkins, St. Louis, Mo.
27	Toronto, Ont. 6/17–21/1907	*Darney H. Maury, Peoria, Ill.
28	Washington, D.C. 5/11–16/1908	*George H. Felix, Reading, Pa.
29	Milwaukee, Wis. 6/ 7–12/1909	*D. W. French, Weehawken, N.J.
30	New Orleans, La. 4/25–29/1910	*William Pitt Mason, Troy, N.Y.
31	Rochester, N.Y. 6/ 5–10/1911	*John Watson Alvord, Chicago, Ill.
32	Louisville, Ky. 6/ 3–7/1912	*Alexander Milne, St. Catharines, Ont.
33	Minneapolis, Minn. 6/23–27/1913	*Dow R. Gwinn, Terre Haute, Ind.
34	Philadelphia, Pa. 5/11–15/1914	*Robert J. Thomas, Lowell, Mass.
35	Cincinnati, Ohio 5/10–14/1915	*George Goodell Earl, New Orleans, La.
36	New York, N.Y. 6/ 5–9/1916	*Nicholas Snowden Hill Jr., New York, N.Y.
37	Richmond, Va. 5/ 7–11/1917	*Leonard Metcalf, Boston, Mass.
38	St. Louis, Mo. 5/13–17/1918	*Theodore A. Leisen, Detroit, Mich.
39	Buffalo, N.Y. 6/ 9–13/1919	*Charles R. Henderson, Davenport, Iowa
40	Montreal, Que. 6/21–25/1920	*Carleton E. Davis, Philadelphia, Pa.
41	Cleveland, Ohio 6/ 6–10/1921	Beekman C. Little, Rochester, N.Y.
42	Philadelphia, Pa. 5/15–19/1922	*Edward Bartow, Iowa City, Iowa
43	Detroit, Mich. 6/21–25/1923	*Willard S. Cramer, Lexington, Ky.
44	New York, N.Y. 5/19–23/1924	*George W. Fuller, New York, N.Y.
45	Louisville, Ky. 4/27–5/1/1925	*Frank C. Jordan, Indianapolis, Ind.
46	Buffalo, N.Y. 6/ 7–11/1926	*Harry F. Huy, Buffalo, N.Y.
47	Chicago, Ill. 6/ 6–11/1927	*Allan W. Cuddeback, Paterson, N.J.

* Deceased.

	Convention Place & Time	President
48	San Francisco, Calif. 6/11–15/1928	*James E. Gibson, Charleston, S.C.
49	Toronto, Ont. 6/24–28/1929	William W. Brush, New York, N.Y.
50	St. Louis, Mo. 6/ 2–6/1930	*Jack J. Hinman Jr., Iowa City, Iowa
51	Pittsburgh, Pa. 5/25–29/1931	*George H. Fenkell, Detroit, Mich.
52	Memphis, Tenn. 5/ 2–6/1932	Ross L. Dobbin, Peterborough, Ont.
53	Chicago, Ill. 6/12–16/1933	George W. Pracy, San Francisco, Calif.
54	New York, N.Y. 6/ 4–8/1934	Malcolm Pirnie, New York, N.Y.
55	Cincinnati, Ohio.....5/ 6–10/1935	Harry E. Jordan, Indianapolis, Ind.
56	Los Angeles, Calif. 6/ 8–12/1936	*Frank A. Barbour, Boston, Mass.
57	Buffalo, N.Y. 6/ 7–11/1937	William W. Hurlbut, Los Angeles, Calif.
58	New Orleans, La. 4/24–28/1938	*Eugene F. Dugger, Newport News, Va.
59	Atlantic City, N.J. 6/11–15/1939	Reeves Newsom, New York, N.Y.
60	Kansas City, Mo. 4/21–25/1940	*J. Arthur Jensen, Minneapolis, Minn.
61	Toronto, Ont. 6/22–26/1941	*Norman J. Howard, Toronto, Ont.
62	Chicago, Ill. 6/21–25/1942	Louis R. Howson, Chicago, Ill.
63	Cleveland, Ohio.....6/15–18/1943	Abel Wolman, Baltimore, Md.
64	Milwaukee, Wis. 6/13–16/1944	Samuel B. Morris, Los Angeles, Calif.
65	*No Convention* ..... — 1945	Samuel F. Newkirk Jr., Elizabeth, N.J.
66	St. Louis, Mo. 5/ 6–10/1946	Leonard N. Thompson, St. Paul, Minn.
67	San Francisco, Calif. 7/21–25/1947	Wendell R. LaDue, Akron, Ohio
68	Atlantic City, N.J. 5/ 3–7/1948	N. T. Veatch, Kansas City, Mo.
69	Chicago, Ill. 5/30–6/3/1949	*Linn H. Enslow, New York, N.Y.
70	Philadelphia, Pa. 5/21–26/1950	A. P. Black, Gainesville, Fla.
71	Miami, Fla. 4/29–5/4/1951	*W. Victor Weir, St. Louis, Mo.
72	Kansas City, Mo. 5/ 4–9/1952	Albert E. Berry, Toronto, Ont.
73	Grand Rapids, Mich. 5/10–15/1953	Charles H. Capen, Wanaque, N.J.
74	Seattle, Wash. 5/23–28/1954	Morrison B. Cunningham, Oklahoma City, Okla.
75	Chicago, Ill. 6/12–17/1955	*Dale L. Maffitt, Des Moines, Iowa
76	St. Louis, Mo. 5/ 6–10/1956	*Frank C. Amsbary Jr., Champaign, Ill.
77	Atlantic City, N.J. 5/12–17/1957	Paul Weir, Atlanta, Ga.
78	Dallas, Tex.....4/20–25/1958	Fred Merryfield, Corvallis, Ore.
79	San Francisco, Calif.....7/12–19/1959	Lewis S. Finch, Indianapolis, Ind.
80	Bal Harbour, Fla. 5/15–20/1960	Lauren W. Grayson, Glendale, Calif.
81	Detroit, Mich. 6/ 4–9/1961	C. F. Wertz, Miami, Fla.

* Deceased.

SUMMARY OF MEMBERSHIP

June 30, 1961

Honorary and Life Members	508
Active Members	11,152
Corporate Members and Municipal Service Subscribers	1,287
Associate Members	311
Student Members	46
Total	**13,304**

Section Membership, Geographic Area, and Date of Formation

Section	Year Formed	Territory Included	No. of Members
Alabama-Mississippi	1947	Ala., Miss.	250
Arizona	1947	Ariz.	111
California	1920	Calif., w. Nev.	1,717
Canadian	1916	Canada	790
Chesapeake	1948	Del., D.C. Md.	318
Connecticut	1960	Conn.	116
Cuban	1940	Cuba	10
Florida	1926	Fla.	423
Illinois	1915	Ill.	704
Indiana	1925	Ind.	499
Intermountain	1958	Utah, s. Idaho, e. Nev.	102
Iowa	1915	Iowa	227
Kansas	1946	Kan.	245
Kentucky-Tennessee	1925	Ky., Tenn.	251
Michigan	1938	Mich.	543
Missouri	1946	Mo.	245
Montana	1926	Mont.	74
Nebraska	1947	Neb.	115
New England	1930	Me., Mass., N.H., R.I., Vt.	188
New Jersey	1935	N.J.	580
New York	1914	N.Y.	938
North Carolina	1921	N.C.	203
North Central*	1916	Minn., N.D.	271
Ohio	1938	Ohio	499
Pacific Northwest	1928	Alaska, n. Idaho, Ore., Wash.	493
Pennsylvania	1949	Pa.	589
Rocky Mountain	1926	Colo., N.M., Wyo.	223
South Dakota	1960	S.D.	52
Southeastern	1929	Ga., S.C.	324
Southwest	1934	Ark., La., Okla., Tex.	1,175
Virginia	1934	Va.	218
West Virginia	1938	W.Va.	127
Wisconsin	1924	Wis.	332
Unassigned			352

* Organized as "Minnesota" Section.

DIRECTORY OF COMMITTEES

As of August 1, 1961

All AWWA committees and task groups are given a designation consisting of a four-digit number and (except Board committees) a letter. The 1000 series applies to Board committees; the 2000 series, to developmental committees and task groups; the 3000 series to committees coordinated by the Committee on Research; the 4000 series, to committees coordinated by the Committee on Professional and Administrative Practice; the 5000 series, to committees coordinated by the Committee on Education; and the 6000, 7000, and 8000 series, to committees coordinated by the Committee on Standardization. Gaps have been left in the numerical designation system to accommodate future committees. The letter *M, R, P,* or *D* following the number of a committee indicates that it operates in the field of interest of the Water Utility Management, Water Resources, Water Purification, or Water Distribution Division, respectively. The letter *J* designates joint committees with other organizations. The index below and on the next page provides a detailed outline of the system. (It will be noted that joint committees are indexed twice—in numerical order and, for convenient reference, as a group under the heading "Joint Committees With Other Organizations.")

The committee and task group members listed (pp. 49–62) are those appointed for the calendar year 1961 or for the Association year 1961–62. The President and Vice-President are ex officio members of all AWWA committees, but are generally listed by name only in committees to which they were appointed as individuals before becoming officials of the Association.

INDEX

page

1000—Committees of the Board

1010—Executive 49
1020—General Policy 49
1030 J—Joint Policy Committee 49
1040—Finance 49
1050—Administrative Com. for AWWA Employee Benefits 49
1060—Technical Program 49
1070—Constitution and Bylaws 49
1080—Honorary Membership 49
1090—John M. Diven Memorial Medal 49
1100—AWWA Publications Award 49
1110—Convention Place 49
1120—Convention Management 49
1130—National Water Policy 49
1140—Water Utility Advancement 49
1141 J—Joint Council on Advancement 50
1150—Membership Promotion 50
1160—Admissions 50
1170—Jordan Scholarship Award 50
1180—Water Utility Membership Award 50
1190—Senior Membership Fund 50
1200—International Affairs 50
1550—Ad Hoc Com. on Review of AWWA Aims and Objectives 50
1570—Ad Hoc Com. on Hill Cup Competition ... 51
1580—Ad Hoc Com. on Establishment of AWWA Affiliates 51
1600—Ad Hoc Com. on Classification of AWWA Publications 51
1610—Ad Hoc Com. to Review Fluoridation Policy 51

2000—Developmental Committees and Task Groups

2200 M—Water Utility Management 51
2210 M—Task Group on Job Classifications ... 51
2220 M—Task Group on Review and Redevelopment of a Rating Scale for Water Utilities 51
2221 M—Financing, Rate Structure, and Metering 51
2222 M—Accounting, Collecting, and Recording 51
2223 M—Organization, Management, and Training 51
2224 M—Supply, Transmission, and Pressure 51
2225 M—Purification and Treatment 52
2226 M—Distribution 52
2230 M—Com. to Cooperate With NARUC Com. on Revision of System of Accounts for Water Utilities 52
2240 M—Com. to Cooperate With NARUC Com. on Proposed Rules and Regulations Governing Water Service 52
2400 R—Water Resources 52
2410 R—Task Group on Weather Control 52
2430 R—Task Group on Watershed Protection and Control 52
2440 R—Task Group on Artificial Ground Water Recharge 52
2450 R—Task Group on Underground Waste Disposal and Control 52
2460 R—Task Group on Operating Experiences Under New Water Laws 52
2470 R—Task Group on Raw-Water Quality .. 52
2480 R—Task Group on Monomolecular-Film Techniques for Evaporation Control 52
2600 P—Water Purification 52
2610 P—Advisory Com. on Chromium and Cadmium Solubility and Toxicity 52
2620 P—Task Group on Fluoridation Materials and Methods 52
2630 P—Task Group on Instrumentation and Methods of Testing Radioactive Contamination in Water 52
2660 P—Task Groups on Synthetic Detergents 52
2661 P—Effects on Water Supplies 52
2662 P—Analytical Methods 52
2670 P—Task Group on Biologic Infestation of Purified Water 53

page

2680 P—Task Group on Manganese Deposition in Pipelines ... 53
2690 P—Task Group on Cold-Water Corrosion of Copper ... 53
2700 P—Advisory Com. on Research on Water Coagulation ... 53
2710 P—Task Group on Diatomite Filtration ... 53
2720 P—Task Group on Filtrability Index Test 53
2740 P—Task Group on Research Study on Impurities in Liquid Chlorine ... 53
2750 P—Task Group on Ion Exchanger Test Procedures ... 53
2800 D—Water Distribution ... 53
2810 D—Advisory Com. on Effect of Purification Methods on Water Main Carrying Capacities ... 53
2811 D—Task Group on Protective Coatings for Water Distribution Systems ... 53
2820 D—Task Group on Evaluation of Type K and L Copper Tubing for Water Service ... 53
2830 D—Task Group on Standard for Distribution System Maintenance and Operation ... 53
2840 D—Task Group on Report Form for Water Main Breaks ... 53

3000—Research Committees

3000—*Committee on Research* ... 54
3110 P—Viruses in Water ... 54
3120 P—Saline Water Conversion ... 54

4000—Professional and Administrative Practice Committees

4000—*Committee on Professional and Administrative Practice* ... 54
4100 M—Organization and Administrative Policy 54
4110 M—Constitutional and Statutory Aspects of Municipal Water Utility Organization ... 54
4120 M—Radio and Mobile Communication Facilities for Water Utilities ... 54
4121 J—National Com. for Utilities Radio ... 54
4130 M—Water Use in Air Conditioning and Other Refrigeration ... 54
4140 M—Water Use in Fire Prevention and Protection ... 54
4150 M—Taxation and Revenue Allocation ... 54
4160 J—American Sanitary Engineering Intersociety Board ... 54
4200 M—Public and Worker Relationships ... 55
4220 M—Management Relations ... 55
4230 M—Compensation of Water Utility Personnel ... 55
4240 M—Pension, Retirement, and Other Fringe Benefits ... 55
4250 M—Safety Practices ... 55
4270 J—Certification of Water Utility Personnel 55
4300 M—Financing ... 55
4310 M—Construction, Equipment, and Materials Contracts ... 55
4320 M—Valuation and Depreciation ... 55
4330 M—Cost Trends ... 55
4340 M—Water Main Extension Policy ... 55
4400 M—Accounting and Statistics ... 55
4410 M—Water Department Reports ... 55
4420 M—Water Rates ... 55
4430 M—Joint Administration of Water and Sewerage Facilities ... 55
4440 M—Water Use ... 55
4450 M—Revenue-Producing Water ... 55
4460 J—Revision of Manual of Water Works Accounting ... 55

5000—Education Committees

5000—*Committee on Education* ... 56
5110 M—Preparation of Training Manuals ... 56

6000–8000—Standardization Committees

6000—*Committee on Standardization* ... 56
(6100–6900—Resources)
6200—Watersheds ... 56
6210 R—Public Use of Watershed Areas ... 56
6300 R—Ground Water ... 56
6310 J—Deep Wells ... 56
(7000—Purification)

page

7100–7200—Treatment ... 56
7110 P—Water Conditioning and Prevention of Corrosion and Incrustation ... 56
7300–7400—Chemicals ... 56
7310 P—Standards and Tests for Water Purification Chemicals ... 56
7311 P—Advisory Com. for Review of Chemical Standards ... 56
7320 P—Standards for Liquid Chlorine ... 56
7330 J—Chlorine Supply ... 56
7340 P—Quicklime and Hydrated Lime ... 56
7500–7600—Pollution and Quality Control ... 57
7510 J—Oil Line River Crossings ... 57
(8000–8800—Distribution)
8100—Hydraulics ... 57
8120 D—Spillway Design and Channel Capacities ... 57
8130 D—Code for Pressure Piping in Pumping Stations ... 57
8200—Distribution System Maintenance and Operation ... 57
8210 J—Backflow Preventers ... 57
8300–8400—Pipe ... 57
8310 D—Steel Pipe ... 57
8311 J—Field Welding of Steel Water Pipe Joints ... 57
8320 D—Concrete Pressure Pipe ... 57
8330 D—Laying Cast-Iron Pipe ... 57
8340 D—Asbestos-Cement Pipe ... 57
8350 D—Plastic Pipe and Fittings ... 57
8410 D—Water Line Crossings of Highways and Railroads ... 57
8500—Hydrants and Valves ... 58
8510 D—Hydrants ... 58
8520 D—Sluice Gates ... 58
8530 D—Valves ... 58
8531 D—Butterfly Valves ... 58
8600—Meters and Services ... 58
8610 D—Meters ... 58
8620 D—Service Line Materials ... 58
8700—Storage ... 58
8710 J—Steel Standpipes and Elevated Tanks ... 58
8900—Publications ... 58
8910 P—Revision of Water Quality and Treatment ... 58
8920 J—Revision of ASCE Manual 19 ... 58
8930 P—Standard Methods for the Examination of Water and Wastewater ... 58
8931 J—Joint Editorial Board for Twelfth Edition of Standard Methods ... 59
8932 J—Uniformity of Methods of Water Examination ... 59
8940 P—Laboratory Manual ... 59

Joint Committees With Other Organizations

Joint Policy Com. ... 49
Joint Council on Advancement ... 50
National Com. for Utilities Radio ... 54
American Sanitary Engineering Intersociety Board 54
Certification of Water Utility Personnel ... 55
Revision of Manual of Water Works Accounting 55
Deep Wells ... 56
Chlorine Supply ... 56
Oil Line River Crossings ... 57
Backflow Preventers ... 57
Field Welding of Steel Water Pipe Joints ... 57
Steel Standpipes and Elevated Tanks ... 58
Revision of ASCE Manual 19 ... 58
Joint Editorial Board for Twelfth Edition of Standard Methods ... 59
Uniformity of Methods of Water Examination ... 59

Participation on Committees of Other Organizations

American Public Health Assn. ... 60
American Right of Way Assn. ... 60
American Soc. of Mech. Engrs. ... 60
American Soc. for Testing and Materials ... 60
American Standards Assn. ... 60
Chlorine Institute ... 62
Engineers Joint Council ... 62
International Water Supply Assn. ... 62
National Assn. of Corrosion Engrs. ... 62
National Fire Protection Assn. ... 62
Steel Structures Painting Council ... 62
US Dept. of Interior ... 62
US Public Health Service ... 62

COMMITTEE MEMBERSHIP

1000—COMMITTEES OF THE BOARD

1010—Executive

J. W. Cramer *
S. S. Baxter
R. V. Ford
W. D. Hurst
Leo Louis
W. J. Orchard
C. F. Wertz

1020—General Policy

C. F. Wertz *
J. W. Cramer
L. S. Finch
L. W. Grayson
E. M. Jones
Fred Merryfield
H. F. O'Brien

1030 J—Joint Policy Com.

American Water Works Assn.
Water & Sew. Works Mfrs. Assn.
Water Pollution Control Fed.

The Joint Policy Committee was established in 1954 in order to provide a formally organized and permanent agency to consider and make recommendations concerning matters of common interest to the participating associations. Among these matters are: general conventions, exhibits at conventions, publications, joint technical committees, and standards. The Joint Policy Committee will also represent the associations in such federal activities as require joint action.

Committee is inactive at present.

1040—Finance

Reeves Newsom *
C. J. Alfke
W. J. Orchard †
R. J. Faust †

1050—Administrative Com. for AWWA Employee Benefits

Reeves Newsom *
C. J. Alfke
W. J. Orchard #
E. F. Johnson ||

1060—Technical Program

E. S. Cole *
G. E. Arnold §
J. W. Cramer †
R. J. Faust ||

Chairmen of Divisions

J. G. Carns Jr., *Distr.*
C. W. Wilson, *Mgmt.*
J. M. Sanchis, *Purif.*
L. M. Miller, *Res.*

1070—Constitution and Bylaws

J. G. Copley *
E. J. Allen
L. S. Finch
L. W. Grayson
W. J. Orchard
R. J. Faust †

1080—Honorary Membership

L. W. Grayson *
C. F. Wertz
J. W. Cramer

1090—John M. Diven Memorial Medal

1961 Com. for 1962 Award

W. R. LaDue *
H. J. Graeser Jr.
L. R. Howson
H. E. Hudson
R. W. Morse
Gerald Remus

1100—AWWA Publications Award

1961 Com. for 1962 Award

E. S. Cole *
R. E. Dodson Jr.
G. G. Fassnacht
M. B. Gamet

Past-Chairmen of Divisions

H. J. Graeser Jr., *Distr.*
Gerald Remus, *Mgmt.*
H. E. Hudson, *Purif.*
R. W. Morse, *Res.*

1110—Convention Place

AWWA

C. F. Wertz *
J. W. Cramer
R. J. Faust †

WSWMA

G. W. Kelsey
C. V. Roberts
J. G. Stewart †

1120—Convention Management

AWWA

S. S. Baxter *
V. A. Appleyard
G. E. Arnold
J. J. Barr
E. S. Cole †
J. W. Cramer †
G. H. Dann
L. S. Morgan
R. J. Faust †

WSWMA

C. V. Roberts †
J. G. Stewart †

1130—National Water Policy

J. H. Murdoch Jr.*
G. H. Beard †
A. P. Black
E. S. Chase
R. B. Diemer
G. E. Ferguson
Tahlman Krumm
S. B. Morris
N. T. Veatch
Abel Wolman

1140—Water Utility Advancement

R. S. Millar *
L. S. Finch §
W. R. LaDue
J. H. Murdoch Jr.
O. A. Newquist
R. F. Orth
R. H. Trester
Fred Merryfield ‡
E. F. Johnson †

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary. # Treasurer.

1141 J—Joint Council on Advancement

American Water Works Assn.
Water & Sew. Works Mfrs. Assn.
Water Pollution Control Fed.

O. A. Newquist, *AWWA Repr.*
R. F. Orth, *WSWMA Repr.*
G. A. Howell, *WPCF Repr.*

1150—Membership Promotion

H. J. Graeser Jr.*
Leo Louis §
B. G. Bretz
J. J. Carroll
J. J. Davis
D. R. Gannon
Jack Gordon
L. W. Klockner
Frank Marold
G. E. Maxwell
R. E. Moon
C. G. Pettit
G. C. Sopp
E. H. A. Stahl
H. R. Street
R. L. Tyler
J. D. Wedeman
H. F. Zinsmeister

1160—Admissions

S. S. Baxter *
R. V. Ford
H. C. Medbery

1170—Jordan Scholarship Award

1961 Com. for 1962 Award

E. F. Gloyna *
J. J. Davis
Q. B. Graves
J. E. Kiker
J. W. MacKay

1180—Water Utility Membership Award

O. A. Newquist *
G. R. Davis
Bert Gurney
C. C. Lanford
C. K. Wells

1190—Senior Membership Fund

T. L. Amiss
W. W. DeBerard
F. Y. Dorrance
S. B. Morris
C. E. Painter
E. F. Johnson ||

1200—International Affairs

S. L. Kerr *
A. P. Black
E. S. Chase
J. A. Frank
B. S. Grant
H. O. Hartung
Fred Merryfield
T. W. Moses
H. F. O'Brien
W. J. Orchard †
R. F. Orth
T. B. Robinson
H. W. Stuart
A. W. Von Hartz
C. F. Wertz †
R. J. Faust †

1550—Ad Hoc Com. on Review of AWWA Aims and Objectives

F. A. Eidsness *
C. G. R. Armstrong §
C. P. Harnish §
L. S. Finch ‡

Steering Committee

S. S. Baxter *
R. L. Clark
Leo Louis
J. H. Murdoch Jr.
H. F. O'Brien
R. H. Trester
F. A. Eidsness ‡

1551—Education

W. A. Hardenbergh *
F. A. Butrico
Rolf Eliassen
M. B. Gamet
H. P. Kramer
W. L. Mallmann
G. A. Rohlich
I. N. Ronhovde
K. E. Shull
R. E. Stiemke
W. H. Walkinshaw

1552—Engineering

W. W. Aultman *
Richard Hazen §
G. G. Bogren
M. M. Braidech
Frank E. Dolson
Ed Farmer
G. E. Ferguson
W. G. McKay
G. E. M. Proctor
G. S. Rawlins
M. K. Socha
Uel Stephens

1553—Finance and Accounting

W. L. Patterson *
C. R. Erickson §
L. E. Ayres
T. V. Berry
D. L. Erickson
B. S. Grant
A. P. Kuranz
J. R. Pierce
L. T. Reinicker
R. L. Swingley

1554—Materials and Equipment

G. E. Arnold *
R. W. Ockershausen §
R. C. Beam
N. S. Bubbis
M. H. Foley
W. E. Ford
W. R. Godfrey
Bert Gurney
C. W. Hamblin
L. E. Harper
J. L. Hart
R. L. Lawrence
H. F. O'Brien
R. F. Orth
H. S. Price Jr.
T. T. Quigley
W. O. Randall
Gerald Remus
J. S. Slicer Jr.
R. C. Sparling
W. F. Turney
J. M. Wafer

1555—Operation and Management—Large Utilities

M. P. Hatcher *
H. J. Graeser Jr.§
E. J. Allen
J. J. Barr
S. S. Baxter
H. H. Gerstein
George Hodge
J. D. Kline
D. P. Morse
X. D. Murden
J. H. Turner
C. F. Wertz

1556—Operation and Management—Small Utilities

H. F. Seidel *
J. L. Haley §
C. S. Anderson
S. E. Harris
W. A. Kramer
R. H. Lancaster
B. R. Lapp
C. C. Leeke
M. H. McGuire
Henry Wilkens Jr.

1557—Public Health

A. N. Beck
E. F. Gloyna
L. D. Matter
G. E. McCallum
J. R. Menzies
O. J. Muegge
B. A. Poole

1558—Research

T. E. Larson *
L. E. Tabor §
H. A. Faber
P. D. Haney
S. H. Hopper
A. A. Kalinske
V. W. Langworthy
D. A. Okun
W. B. Schworm
J. K. G. Silvey
R. E. Thompson
W. W. Towne

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.

1559—Section Secretaries

J. H. Bass *
L. S. Morgan §
H. W. Badley
Kimball Blanchard
C. H. Canham
A. W. Clarkson
N. M. deJarnette
R. E. Dodson Jr.
Mae Grove
J. J. Hail
L. A. Jackson
F. D. Jones
J. G. Simmons

1560—Service to Members

V. A. Appleyard *
Leo Louis §
S. C. Casteel
J. G. Copley
K. F. Hoefle
E. M. Jones
J. B. Kinney
J. W. McFarland
H. S. Merz
Garrett Sloan
H. P. Stockwell Jr.
C. W. Wilson

1561—Water Quality and Treatment

H. E. Hudson *
H. C. Medbery §
W. R. Conley Jr.
R. L. Derby
Oscar Gullans
H. O. Hartung
K. F. Knowlton
H. E. Lordley
G. W. Moore
H. E. Pearson
A. H. Rice
T. M. Riddick
M. J. Taras
A. H. Ullrich
D. B. Williams

1562—Water Supply Industry Publications

W. S. Foster *
G. E. Symons §
C. H. Billings
M. M. Cohn
A. J. Fox Jr.
R. O. Gresham
F. C. Maurer
J. P. Russell

1570—Ad Hoc Com. on Hill Cup Competition

H. H. Gerstein *
L. H. Coult
C. P. Harnish
W. R. LaDue
E. F. Johnson ||

1580—Ad Hoc Com. on Establishment of AWWA Affiliates

L. S. Finch *
C. S. Anderson
J. J. Davis
F. A. Eidsness
H. J. Graeser Jr.
R. P. Lowe
J. C. Luthin
H. C. Medbery
J. W. Spencer

1600—Ad Hoc Com. on Classification of AWWA Publications

A. E. Griffin *
E. S. Cole
H. H. Gerstein
L. R. Howson
W. R. LaDue
Paul Weir

1610—Ad Hoc Com. to Review Fluoridation Policy

A. P. Black *
A. E. Berry
J. R. Doty
H. A. Faber

2000—DEVELOPMENTAL COMMITTEES AND TASK GROUPS

With the activation of two new standing committees—on research (Committee 3000) and education (Committee 5000), it is anticipated that at least some of the committees listed below will be placed under their jurisdiction. As of Aug. 1, 1961, this matter was still under consideration.

2200 M—*Water Utility Management*

Division Officers

C. W. Wilson, *Chm.*
J. G. Copley, *Vice-Chm.*
P. C. Karalekas, *Secy.*
G. D. Burr, *Trustee*
H. H. Gerstein, *Trustee*
Gerald Remus, *Past-Chm.*

2210 M—Task Group on Job Classifications

R. S. Millar *
H. S. Baarslag
J. M. Brown
D. P. Morse
G. C. Sopp
W. J. Stephens ‡

2220 M—Task Group on Review and Redevelopment of a Rating Scale for Water Utilities

J. H. Murdoch Jr.*
C. P. Abraham
G. E. Arnold
R. W. Kean
P. S. Wilson ||

General Consultants

O. E. Brownell
K. J. Carl
E. S. Chase
T. C. Earl
W. C. Welmon

2221 M—Financing, Rate Structure, and Metering

W. L. Patterson *
M. P. Hatcher
R. G. Kincaid

2222 M—Accounting, Collecting, and Recording

R. L. Swingley *
S. E. Kerr
H. L. Plowman Sr.

2223 M—Organization, Management, and Training

Henry Wilkens Jr.*
A. R. Davis
W. K. Van Zandt

2224 M—Supply, Transmission, and Pressure

H. T. Critchlow *
C. H. Capen
James Girand
W. J. Orchard
P. S. Wilson

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.

2225 M—Purification and Treatment

E. L. Bean *
H. O. Hartung
H. E. Hudson
R. L. Woodward

2226 M—Distribution

L. J. Alexander *
L. W. Grayson
M. K. Socha

2230 M—Com. to Cooperate With NARUC Com. on Revision of System of Accounts for Water Utilities

J. J. Barr, *Adviser*

2240 M—Com. to Cooperate With NARUC Com. on Proposed Rules and Regulations Governing Water Service

J. H. Murdoch Jr.*
G. E. Arnold
E. A. Bell
T. C. Earl
James Girand
Peter Ley
Leo Louis
C. R. Morris
J. W. Myers Jr.
Paul Weir
W. C. Welmon

2400 R—*Water Resources*

Division Officers

L. M. Miller, *Chm.*
I. E. Anderson, *Vice-Chm.*
G. H. Beard, *Secy.*
H. P. Stockwell, *Trustee*
J. E. Williams, *Trustee*
R. W. Morse, *Past-Chm.*

2410 R—Task Group on Weather Control

To be reorganized.

2430 R—Task Group on Watershed Protection and Control

E. J. Allen *

2440 R—Task Group on Artificial Ground Water Recharge

J. J. Baffa *
H. C. Barksdale
C. H. Bechert
M. L. Brashears
C. R. Compton
F. B. Laverty
L. B. Losee
A M Rawn
Max Suter
L. F. Warrick
W. F. Welsch

2450 R—Task Group on Underground Waste Disposal and Control

L. M. Miller, *Adviser*

2460 R—Task Group on Operating Experiences Under New Water Laws

G. E. Ferguson *
H. O. Banks
J. C. Detweiler
R. M. Dixon

2470 R—Task Group on Raw-Water Quality

J. R. Hem *

2480 R—Task Group on Monomolecular-Film Techniques for Evaporation Control

To be organized.

2600 P—*Water Purification*

Division Officers

J. M. Sanchis, *Chm.*
A. H. Ullrich, *Vice-Chm.*
H. P. Kramer, *Secy.*
J. F. Dye, *Trustee*
J. C. Vaughn, *Trustee*
H. E. Hudson, *Past-Chm.*

2610 P—Advisory Com. on Chromium and Cadmium Solubility and Toxicity

R. U. Byerrum *
A. P. Black
E. J. Cleary
Douglas Feben
T. K. McCormack
Eskel Nordell
T. M. Riddick
M. L. Riehl
W. F. Shephard
H. L. Shuldener
R. O. Van Meter
Frank Princi ‡

2620 P—Task Group on Fluoridation Materials and Methods

F. J. Maier *
R. L. Derby
H. A. Faber
A. E. Griffin
L. E. Harper
W. L. Harris
O. J. Muegge
R. W. Ockershausen
R. S. Phillips
R. C. Pickard
F. S. Taylor
H. W. Tracy
D. B. Williams
J. C. Zufelt

2630 P—Task Group on Instrumentation and Methods of Testing Radioactive Contamination in Water

H. E. Pearson *
C. W. Christenson
H. H. Gerstein
W. R. Ree Jr.
H. G. Swope
F. S. Taylor
J. C. Vaughn
W. F. Bale ‡
R. L. Butenhoff ‡
L. R. Setter ‡

2660 P—Task Groups on Synthetic Detergents

2661 P—Effects on Water Supplies

P. D. Haney *
R. L. Culp
J. D. Enright
W. D. Hatfield
H. P. Kramer
H. E. Lordley
J. C. Vaughn
P. J. Weaver

2662 P—Analytical Methods

J. C. Vaughn *
G. P. Edwards
R. F. Falkenthal
H. P. Kramer
H. F. Laughlin
R. W. Schmidt
P. J. Weaver
W. F. White
George Flood ‡

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.

2670 P—Task Group on Biologic Infestation of Purified Water

M. P. Crabill *
R. J. Becker
R. L. Derby
W. M. Ingram
H. J. Ongerth
C. M. Palmer
C. E. Renn
J. K. G. Silvey
T. A. Olsen ‡

2680 P—Task Group on Manganese Deposition in Pipelines

A. E. Griffin *
J. S. Kneale §
R. B. Adams
R. E. Dodson Jr.
R. S. Ingols
H. C. Myers

2690 P—Task Group on Cold-Water Corrosion of Copper

K. E. Shull *
R. J. Becker
T. E. Larson
A. J. Minkus
Lee Streicher
D. B. Williams
A. I. Heim ‡

2700 P—Advisory Com. on Research on Water Coagulation

A. P. Black *
R. H. Babcock
J. R. Baylis
A. M. Buswell
T. R. Camp
D. C. Carmichael
J. M. Cohen
F. A. Eidsness
Douglas Feben
H. O. Hartung
C. R. Henry
W. F. Langelier
H. F. Ludwig
E. A. Savinelli
W. B. Schworm
O. G. Brown ‡
W. G. Woxholt ‡

2710 P—Task Group on Diatomite Filtration

E. R. Baumann *
G. R. Bell
J. V. Feuss
P. D. Haney
G. W. Moore
J. M. Sanchis
R. P. Schmitt
Henry Armbrust ‡

2720 P—Task Group on Filtrability Index Test

J. M. Sanchis *
C. M. Bach
Lawrence Beebe
J. A. Borchardt
Eugene Bowers
J. F. Dye
Douglas Feben
Oscar Gullans
D. H. Matheson
J. R. Popalisky
P. L. Boucher ‡

2740 P—Task Group on Research Study on Impurities in Liquid Chlorine

Thomas De Vries *
R. J. Baker
R. H. Condell
H. A. Faber
Oscar Gullans
E. J. Laubusch
H. W. Tracy

2750 P—Task Group on Ion Exchanger Test Procedures

Eugene Bowers *
T. C. Hoppe
Sidney Sussman
H. G. Swope

Advisers

A. R. Belyea
J. J. Brozzo
Calvin Calmon
B. N. Dickinson
J. H. Duff
A. M. Fradkin
Robert Kunin

2800 D—*Water Distribution*

Division Officers

J. G. Cairns Jr., *Chm.*
A. H. Rice, *Vice-Chm.*
E. B. Cobb, *Secy.*
V. A. Appleyard, *Trustee*
C. F. Buettner, *Trustee*
H. J. Graeser Jr., *Past-Chm.*

2810 D—Advisory Com. on Effect of Purification Methods on Water Main Carrying Capacities

E. S. Cole *
E. E. Erickson
Ed Farmer
M. E. Flentje
J. A. Frank
A. E. Griffin
Leo Louis
W. E. MacDonald
S. T. Powell
M. J. Taras
E. F. Wagner ‡

2811 D—Task Group on Protective Coatings for Water Distribution Systems

R. F. McCauley *
J. R. Baylis
A. P. Black
J. F. Dye
J. J. Erdei
M. E. Flentje
A. J. Minkus
G. D. Norcom
H. E. Pearson

2820 D—Task Group on Evaluation of Types K and L Copper Tubing for Water Service

A. C. Michael *
E. H. Aldrich
A. I. Heim
H. A. Kerby
W. R. LaDue
K. E. Shull

2830 D—Task Group on Standard for Distribution System Maintenance and Operation

To be organized.

2840 D—Task Group on Report Form for Water Main Breaks

To be organized.

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.

3000—RESEARCH COMMITTEES

It is anticipated that certain committees and task groups now assigned elsewhere will be placed under the jurisdiction of the Committee on Research. As of Aug. 1, 1961, this matter was still under consideration, but two committees had been so assigned by action of the Board of Directors.

3000—Committee on Research

T. E. Larson *
R. L. Culp ‡
D. H. Matheson
K. E. Shull
J. K. G. Silvey
H. W. Stuart
J. B. Ramsey #

Division Representatives

E. B. Cobb, *Distr.*
G. D. Burr, *Mgmt.*
J. C. Vaughn, *Purif.*
I. E. Anderson, *Res.*

3110 P—Viruses in Water

H. O. Hartung *
H. A. Faber
H. E. Hudson
P. W. Kabler
W. W. Sanderson
D. B. Williams
R. L. Woodward

3120 P—Saline Water Conversion

Rolf Eliassen *
J. D. Bakken
Allen Cywin
L. S. Finch
W. E. Katz
Louis Koenig
Fred Loebel
R. W. Morse
E. H. Sieveka

4000—PROFESSIONAL AND ADMINISTRATIVE PRACTICE COMMITTEES

4000—Committee on Professional and Administrative Practice

W. R. LaDue *
L. S. Finch ‡
J. J. Barr
E. L. Bean
E. S. Cole
J. G. Copley
G. H. Dyer
M. P. Hatcher
H. E. Hudson
J. M. Jester
A. P. Kuranz
R. J. McLeod
R. S. Millar
J. H. Murdoch Jr.
R. L. Swingley
L. N. Thompson
A. A. Ulrich
D. B. Preston #

4100 M—*Organization and Administrative Policy*

M. P. Hatcher, *Gen. Chm.*

4110 M—Constitutional and Statutory Aspects of Municipal Water Utility Organization

Inactive.

4120 M—Radio and Mobile Communication Facilities for Water Utilities

J. M. Jester *
M. B. Cunningham
F. E. Dolson
R. E. Hemborg

4121 J—National Com. for Utilities Radio

Representatives of AWWA

J. M. Jester *
M. B. Cunningham
D. B. Preston

4130 M—Water Use in Air Conditioning and Other Refrigeration

E. L. Bean *
C. M. Bosworth
H. F. Seidel
M. C. Smith

4140 M—Water Use in Fire Prevention and Protection

A. A. Ulrich *
C. J. Alfke
K. J. Carl
R. O. Ellis
W. R. Gelston
L. W. Grayson
C. J. Itter
J. H. Murdoch Jr.
Reeves Newsom
M. J. Shelton
J. S. Slicer Jr.

4150 M—Taxation and Revenue Allocation

Not yet activated.

4160 J—American Sanitary Engineering Intersociety Board

American Institute of Chemical Engrs.
American Public Health Assn.
American Soc. of Civil Engrs.
American Soc. for Engineering Education
American Water Works Assn.
Water Pollution Control Fed.

Representatives of AWWA

W. R. LaDue
R. D. Mitchell
R. E. Stiemke

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.
# Representing the Executive Secretary, who is committee secretary.

4200 M—*Public and Worker Relationships*

Not yet activated.

4220 M—Management Relations

Not yet activated.

4230 M—Compensation of Water Utility Personnel

G. H. Dyer *
J. M. Brown
W. R. Gelston
H. J. Graeser Jr.
J. C. Luthin
R. A. Thompson Jr.

4240 M—Pension, Retirement, and Other Fringe Benefits

J. G. Copley *
C. R. Erickson
M. P. Hatcher
P. C. Karalekas
A. P. Kuranz
Leo Louis
D. P. Morse

4250 M—Safety Practices

D. B. Preston *
W. W. Anders
D. A. Blackburn
J. G. Cowan
R. A. Edwards
Earl Frederiksen
Oscar Gullans
G. L. E. Linn
J. A. Novaro
J. B. Stevens
A. J. Webb
J. C. Zufelt
W. R. LaDue ‡

4270 J—Certification of Water Utility Personnel

American Water Works Assn.
Conf. of State San. Engrs.
Water Pollution Control Fed.

J. R. Fleming *
G. W. Burke Jr.‡

AWWA

F. J. Burgess
J. E. Vogt
D. B. Preston

CSSE

G. G. Fassnacht
R. C. Pickard
J. E. Trygg

WPCF

W. M. Bingley
W. A. Hasfurther
Sol Seid

4300 M—*Financing*

M. P. Hatcher, *Gen. Chm.*

4310 M—Construction, Equipment, and Materials Contracts

Not yet activated.

4320 M—Valuation and Depreciation

Not yet activated.

4330 M—Cost Trends

Not yet activated.

4340 M—Water Main Extension Policy

M. P. Hatcher *
S. T. Anderson
E. F. Dandridge
A. R. Davis
C. M. Hoskinson
D. P. Morse
J. H. Murdoch Jr.
W. R. Seeger

4400 M—*Accounting and Statistics*

A. P. Kuranz, *Gen. Chm.*

4410 M—Water Department Reports

M. P. Hatcher, *Adviser*

4420 M—Water Rates

Inactive.

4430 M—Joint Administration of Water and Sewer Facilities

R. J. McLeod & L. N. Thompson, *Advisers*

4440 M—Water Use

H. E. Hudson *
H. A. Cornell
W. S. Harris
M. P. Hatcher
R. S. Millar
H. F. Seidel
J. B. Wolff
W. R. Wolff

4450 M—Revenue-Producing Water

E. S. Cole *
E. H. Aldrich
E. J. Allen
J. G. Carns
D. W. Johnson
A. P. Kuranz
H. C. Medbery
H. W. Niemeyer
W. K. Van Zandt
H. R. Wright

4460 J—Revision of Manual of Water Works Accounting

American Water Works Assn.
Municipal Finance Officers Assn.

R. L. Swingley *

Representatives of AWWA

A. D. Cox Jr.
W. B. Gamble
H. D. Goff
J. A. Gubanich
J. J. Kenny
H. L. Plowman Sr.
S. I. Roth
W. C. Welmon
C. E. Woods

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.

5000—EDUCATION COMMITTEES

It is anticipated that certain committees and task groups now assigned elsewhere will be placed under the jurisdiction of the Committee on Education. As of Aug. 1, 1961, this matter was still under consideration, but one committee had been so assigned by the Board of Directors.

5000—Committee on Education

H. E. Hudson *
V. A. Appleyard §
A. P. Bernhart
Lloyd Caughran
J. E. McKee
R. E. Stiemke
D. B. Preston #

Division Representatives

V. A. Appleyard, *Distr.*
P. C. Karalekas, *Mgmt.*
H. P. Kramer, *Purif.*
L. M. Miller, *Res.*

5110 M—Preparation of Training Manuals

D. B. Preston *
F. E. Dolson
F. A. Eidsness
Q. B. Graves
E. S. Hopkins
T. E. Larson
Fred Merryfield
I. N. Ronhovde

6000–8000—STANDARDIZATION COMMITTEES

6000—Committee on Standardization

L. R. Howson *
V. C. Lischer §
E. H. Aldrich
C. G. R. Armstrong
E. A. Bell
W. W. DeBerard
F. E. Dolson
C. R. Erickson
D. L. Erickson
L. W. Grayson
R. C. Kennedy
Reeves Newsom
H. F. O'Brien
H. Arthur Price
N. T. Veatch
C. F. Wertz
Abel Wolman
J. B. Ramsey #

6100–6900—RESOURCES

6200—*Watersheds*

6210 R—Public Use of Watershed Areas

To be reorganized.

6300 R—*Ground Water*

G. E. Ferguson, *Adviser*

6310 J—Deep Wells

American Water Works Assn.
National Water Well Assn.

J. C. Harding *
C. R. Erickson
A. G. Fiedler
C. P. Harnish
A. H. Johnson
O. J. Muegge
Reeves Newsom
E. A. Reinke
H. R. Veenstra

Producers

G. H. Beard
F. F. Bock

NWWA

J. F. Guardino
G. M. Galloway

7000—PURIFICATION

7100–7200—*Treatment*

7110 P—Water Conditioning and Prevention of Corrosion and Incrustation

Rolf Eliassen, *Coordinator*

7300–7400—*Chemicals*

7310 P—Standards and Tests for Water Purification Chemicals

J. C. Vaughn, *Coordinator*

7311 P—Advisory Com. for Review of Chemical Standards

Oscar Gullans *
W. L. Harris
M. S. Nichols

7320 P—Standards for Liquid Chlorine

H. A. Faber, *Adviser*

7330 J—Chlorine Supply

American Water Works Assn.
Conf. of State San. Engrs.
US Public Health Service
Water Pollution Control Fed.

R. J. Faust,|| *AWWA Repr.*

H. A. Faber & W. E. Gerdel, *WPCF Repr.*

7340 P—Quicklime and Hydrated Lime

J. F. Dye *
C. A. Black
K. A. Gutschick
H. O. Hartung
J. C. Vaughn

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.
# Representing the Executive Secretary, who is committee secretary.

7500–7600—*Pollution and Quality Control*

7510 J—Oil Line River Crossings

American Water Works Assn.
American Petroleum Institute

AWWA	*API*
M. B. Cunningham	C. C. Keane
E. L. Filby	R. H. Lynch
V. C. Lischer	R. K. Paine
	L. F. Scherer

8000–8800—DISTRIBUTION

8100—*Hydraulics*

8120 D—Spillway Design and Channel Capacities

T. H. Wiggin *	E. F. O'Brien
T. R. Camp	R. E. Oltman
R. D. Goodrich	C. J. Posey
K. R. Kennison	H. A. Vicker

8130 D—Code for Pressure Piping in Pumping Stations

Inactive.

8200—*Distribution System Maintenance and Operation*

8210 J—Backflow Preventers

American Water Works Assn.
Conference of State San. Engrs.

R. L. Derby *

AWWA	*CSSE*
E. J. Allen	W. N. Gahr
G. J. Angele	P. J. Houser
A. T. Dempster	E. C. Meredith
J. S. Slicer Jr.	H. J. Ongerth
	H. E. Wirth

8300–8400—*Pipe*

8310 D—Steel Pipe

H. Arthur Price *	C. W. Wilson
W. W. Hurlbut #	*Producers*
H. K. Anderson	R. C. Beam
R. E. Barnard	W. H. Cates
Abraham Brown	H. J. Easter
G. E. Burnett	G. H. Garrett
C. H. Capen	B. F. Hughes
E. E. Erickson	G. D. Kish
S. L. Kerr	J. E. Revelle
V. C. Lischer	D. A. Stromsoe
G. B. McComb	
J. J. Rossbach	*NEWWA*
G. R. Scott	C. J. Ginder *
J. W. Trahern	C. B. Hardy
T. H. Wiggin	

8311 J—Field Welding of Steel Water Pipe Joints

American Water Works Assn.
American Welding Soc.

AWWA	*AWS*
H. Arthur Price *	R. W. Bennett
R. B. Diemer	I. E. Boberg
G. W. Hamlin	G. H. Garrett
R. C. Kennedy	S. A. Wilson
L. G. Lenhardt	

8320 D—Concrete Pressure Pipe

E. W. Whitlock *	G. L. Curtis
M. K. Socha §	C. D. Herlihy
L. O. Gardner	H. F. Kennison
M. G. Lockwood	
A. C. Michael	*NEWWA*
H. F. Peckworth	S. M. Dore *
R. A. Skinner	S. E. Dore Jr.
	H. G. Dresser
Producers	
C. B. Clinger	

8330 D—Laying Cast-Iron Pipe

E. J. Allen *	J. S. Slicer Jr.
G. F. Buettner	Henry Wilkins Jr.
G. W. Coffin	
G. E. Hands	*Producers*
E. R. Healy	H. W. Stuart
H. E. Lordley	J. T. Vann
H. W. Niemeyer	T. F. Wolfe
B. E. Payne	

8340 D—Asbestos-Cement Pipe

R. H. Ritter *	R. H. Jensen
E. H. Aldrich	X. D. Murden
F. G. Denson	
C. R. Erickson	*Producers*
J. E. Farrell	J. R. Cran
W. R. Gelston	C. R. Meek
J. E. Hale	

8350 D—Plastic Pipe and Fittings

O. J. Muegge *	*Producers*
M. K. Socha	B. S. Montell
J. N. Spaulding	G. H. Reed
	R. J. Sweitzer

8410 D—Water Line Crossings of Highways and Railroads

Leo Louis *	C. B. Trueblood
Morris Becker	L. S. Vance
F. E. Dolson	J. T. Vann
James Girand	H. H. Waddel
J. G. Hendrickson	A. F. Wigglesworth
A. C. Michael	S. A. Wilson
M. K. Socha	William Hedley ‡

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.
# Chairman emeritus.

8500—*Hydrants and Valves*

8510 D—Hydrants

K. J. Carl *
E. A. Bell
James Girand
H. E. Lordley
J. S. Slicer Jr.
T. E. Stanton

Producers

L. A. Camerota
H. F. O'Brien

8520 D—Sluice Gates

Inactive.

8530 D—Valves

L. E. Tabor *
G. E. Arnold
C. F. Buettner
K. J. Carl
A. C. Michael

Producers

H. F. O'Brien
C. H. Simon

NEWWA

R. H. Ellis
J. S. Slicer Jr.

8531 D—Butterfly Valves

F. G. Gordon, *Adviser*

8600—*Meters and Services*

8610 D—Meters

J. G. Carns Jr.*
M. B. Cunningham
J. D. Kline
A. P. Kuranz
R. S. Millar
H. W. Niemeyer
G. C. Sopp
Henry Wilkens Jr.

Producers

H. F. Barrett
W. B. Cambridge
W. C. Flanders
J. E. Johnston
H. E. Kampf
J. F. O'Grady

NEWWA

Reeves Newsom *
F. S. Brainard
R. H. Ellis

8620 D—Service Line Materials

Inactive.

8700—*Storage*

8710 J—Steel Standpipes and Elevated Tanks

American Water Works Assn.
American Welding Soc.
New England Water Works Assn.

J. O. Jackson *

AWWA

D. A. Blackburn
L. R. Howson
N. T. Veatch

Producers

E. D. Curtis
S. A. Wilson

AWS

I. E. Boberg
H. E. Lindberg
G. M. Setzekorn

NEWWA

G. A. Sampson *
Herman Burgi Jr.
C. A. Ellis
J. C. Lawler Jr.

8900—PUBLICATIONS

8910 P—Revision of Water Quality and Treatment

Paul D. Haney *
J. A. Borchardt
Oscar Gullans
A. H. Ullrich
Graham Walton

8920 J—Revision of ASCE Manual 19 (Water Treatment Plant Design)

American Soc. of Civil Engrs.
American Water Works Assn.
Conference of State San. Engrs.

W. W. Aultman *

AWWA

E. H. Aldrich
V. C. Lischer

ASCE

J. R. Baylis

CSSE

G. R. Herzik Jr.

8930 P—Standard Methods for the Examination of Water and Wastewater

M. J. Taras *

Subcommittees on Chemical Methods

Acidity & Alkalinity

J. F. Dye
M. S. Nichols
M. J. Taras #

Aluminum

C. M. Bach
A. E. Greenberg
J. F. Kegebein
R. S. Robertson
K. E. Shull

Ammonia

M. S. Nichols #

Anionic Surfactants

(*under 2662 P*)

Arsenic

D. G. Ballinger *
C. R. Hirth ¶

Barium

L. L. Louden *
J. A. Platte ¶

Boiler Feed & Industrial Water

J. F. Wilkes *
R. W. Lane

Boron

Remo Navone *
Eugene Goldman
L. L. Louden
R. P. Grady ¶

Bromide, Chloride & Iodine

L. L. Louden *#
Eugene Goldman
Maxey Brooke ¶

Cadmium

Remo Navone *
Eugene Goldman
A. G. Mackunas ¶

Calcium, Magnesium & Hardness

Remo Navone *#
D. W. Ebert
Lee Streicher
C. A. Goetz ¶
M. Ota ¶

Carbonate, Bicarbonate & Carbon Dioxide

T. E. Larson #

---

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.
# Also represents AWWA on panel of Joint Committee 8932 J.
¶ Adviser.

CHLORINE (RESIDUAL)
A. E. GRIFFIN
M. J. TARAS #

CHROMIUM
JAMES HICKEY #

COPPER
L. L. LOUDEN *
A. G. MACEJUNAS ¶

FLUORIDE
F. J. MAIER *#
R. E. FRAZIER
R. L. MORRIS
REMO NAVONE
R. S. ROBERTSON
Advisers
ERVIN BELLACK
ANGUS BENTON
S. J. CAMPBELL
ERVIN HINDIN
A. G. MACEJUNAS
ARNOLD WESTERHOLD

IRON
T. E. LARSON *
G. F. LEE
R. L. MORRIS
M. L. RIEHL
J. F. WILKES

LEAD
A. E. GREENBERG #

LITHIUM & STRONTIUM
J. H. HUBBLE
R. W. SCHMIDT
J. C. VAUGHN
J. T. HATCHER ¶

MANGANESE
REMO NAVONE #

METHANE
J. R. ROSSUM *
R. E. FRAZIER
T. E. LARSON

NITRITE
R. E. FRAZIER #

ORGANIC CHEMICALS
F. M. MIDDLETON *
A. E. GREENBERG
G. F. LEE

OZONE
E. L. BEAN *
W. C. RINGER
P. B. WILLIAMS
T. C. MANLEY ¶
C. I. PIERCE ¶

pH
L. L. LOUDEN *#
EUGENE GOLDMAN
REMO NAVONE

PHOSPHATES
J. F. WILKES #

POLAROGRAPHIC METHODS
R. E. FRAZIER *

RADIOACTIVITY
(under 8931 J)
H. E. PEARSON, *AWWA Repr.*

REAGENTS
R. D. POMEROY *#

RESIDUE
J. E. O'BRIEN *#
MORRIS NUSSBAUM
R. S. ROBERTSON

SELENIUM
J. R. ROSSUM *
A. E. GREENBERG
REMO NAVONE
F. H. RAINWATER ¶

SILICA
H. E. PEARSON #

SILVER
EUGENE GOLDMAN *
REMO NAVONE
K. E. SHULL
A. G. MACEJUNAS ¶

SPECIFIC CONDUCTANCE
T. M. RIDDICK #

STANDARD SAMPLES
H. P. KRAMER *
D. G. BALLINGER
D. W. MOELLER ¶

SULFATE
R. C. KRONER
J. E. O'BRIEN #
J. R. ROSSUM
ERVIN BELLACK ¶

SULFIDE
R. D. POMEROY *

TASTE & ODOR
F. M. MIDDLETON *#
J. G. FILICKY
PAUL TAMER

TURBIDITY & COLOR
A. P. BLACK *#
E. R. BAUMANN
K. F. KNOWLTON
J. R. ROSSUM

ZINC
ROLAND GIUSTI *
J. J. CONNORS
V. M. MARCY ¶

General Advisers

D. F. ADERHOLDT
J. D. BECK
R. J. BECKER
G. R. BELL
E. D. BENSING
C. A. BLACK
E. C. BORMAN
H. F. BRUNER
CALVIN CALMON
A. K. CHERRY
N. M. DEJARNETTE
J. F. ERDEI
W. B. FARNHAM
A. V. FORDE
B. L. GRIMES
W. B. HARPER
C. R. HENRY
A. A. HIRSCH
R. C. HOATHER
G. U. HOUGHTON
RAY KAPLAN
S. R. KIN
R. S. KINNIBURGH
J. W. KRASAUSKAS
W. L. LAMAR
MAXIM LIEBER
E. A. LOFT
D. M. LONG
F. J. LUDSACK
J. J. MAGUIRE
V. M. MARCY
D. H. MATHESON
W. Y. MCINTIRE
J. S. MCREYNOLDS
C. E. MOORE
J. W. MURPHREY
C. S. MYERS
J. J. NELSON
R. F. PACKHAM
A. T. PALIN
J. M. PAPPENHAGEN
C. P. RODDY
M. W. SKOUGSTAD
C. M. SILVA
E. W. TAYLOR
W. W. ULLMANN
I. W. WALLING
J. G. WEART
H. J. WEBB
D. B. WILLIAMS
W. G. WOXHOLT
M. W. ZIM

8931 J—JOINT EDITORIAL BOARD FOR TWELFTH EDITION OF STANDARD METHODS

American Public Health Assn.
American Water Works Assn.
Water Pollution Control Fed.

M. J. TARAS, *AWWA Repr.*
F. W. GILCREAS, *APHA Repr.*
R. S. INGOLS, *WPCF Repr.*

The Joint Editorial Board has created a Joint Radiological Committee, on which H. E. PEARSON represents AWWA.

8932 J—UNIFORMITY OF METHODS OF WATER EXAMINATION

M. J. TARAS, *AWWA Repr.*

The following organizations are represented on this committee: American Petroleum Inst., American Public Health Assn., American Soc. of Mechanical Engrs., American Soc. for Testing and Materials, American Water Works Assn., Assn. of Official Agricultural Chemists, Manufacturing Chemists Assn., Technical Assn. of Pulp & Paper Industry, US Geological Survey, US Pharmacopoeial Convention, US Public Health Service (R. A. Taft Sanitary Engineering Center), and Water Pollution Control Fed. (AWWA representatives on JCUMWE panels are indicated by # in the list of subcommittees under Committee 8930 P.)

8940 P—Laboratory Manual

M. J. TARAS *
N. M. DEJARNETTE
J. F. ERDEI
H. P. KRAMER
F. J. MAIER
D. H. MATHESON
J. E. O'BRIEN
K. E. SHULL
H. J. WEBB
D. B. WILLIAMS

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.
# Also represents AWWA on panel of Joint Committee 8932 J.
¶ Adviser.

PARTICIPATION ON COMMITTEES OF OTHER ORGANIZATIONS

AMERICAN PUBLIC HEALTH ASSN.

Civilian Defense

R. J. Faust, *AWWA Repr.*

Advisory Com. Engineering Section

R. J. Faust, *AWWA Repr.*

Engineering Section Com. on Water Supply

R. J. Faust, *AWWA Repr.*

Water Resources

R. J. Faust, *AWWA Repr.*

AMERICAN RIGHT OF WAY ASSN.

National Liaison Committee

S. S. Baxter & R. J. McLeod, *AWWA Repr.*

AMERICAN SOC. OF MECH. ENGRS.

Boiler Feedwater Research Com.

M. D. Baker & S. T. Powell, *AWWA Repr.*

AMERICAN SOC. FOR TESTING AND MATERIALS

Materials and Testing Standards Board

R. J. Faust, *AWWA Repr.*

ASTM Committees

C17—Asbestos-Cement Products

Edward Feldman & E. E. Stearns, *AWWA Repr.*

D19—Industrial Water Supply—Task Group on Ion Exchange Materials

Sidney Sussman, *AWWA Repr.*

D20—Plastic Pipe

J. B. Ramsey, *AWWA Repr.*

AMERICAN STANDARDS ASSN.

Board of Directors

Reeves Newsom, *AWWA Repr.*

Standards Council

R. J. Faust, *AWWA Repr.*
W. T. Ingram, *Alternate*

Committees Operating Under ASA Procedure

A13—Scheme for Identification of Piping Systems

American Soc. of Mech. Engrs.
National Safety Council

R. J. Faust, *AWWA Repr.*

A21—Standards for Cast-Iron Pipe and Fittings

American Gas Assn.
American Soc. for Testing and Materials
American Water Works Assn.
New England Water Works Assn.

In addition to the above sponsors, the following organizations are cooperating in the work of this committee: American Soc. of Civil Engrs.; American Soc. of Mech. Engrs.; Cast Iron Pipe Research Assn.; Mfrs. Standardization Soc. of the Valve and Fittings Industry; and Standardization Div., General Services Administration, US Government.

E. B. Cobb *
H. W. Stuart §
H. P. Hagedorn #
K. W. Henderson
R. C. Holcombe
L. R. Howson
R. H. Jensen
S. L. Kerr
G. A. MacDonald
W. T. Thomasson
J. T. Vann
T. F. Wolfe
R. J. Faust ||

Subcommittee on Pipe

J. T. Vann *
E. B. Cobb §
F. E. Dolson
R. C. Holcombe
R. H. Jensen
R. C. Kauffman
L. E. Tabor

Producers
L. A. Camerota
C. A. Henrikson
C. C. Salvage
S. P. Teague

Subcommittee on Joints for Pipe and Fittings

R. H. Jensen *
H. W. Stuart §
H. W. Niemeyer
R. L. Orndorff
William Towner

Producers
L. A. Camerota
Bruce Dedman
G. E. MacDonald
E. C. Sears

Subcommittee on Fittings

H. W. Stuart *
S. L. Kerr §
V. C. Lischer
Roy Ruggles
A. Rynders

Producers
C. A. Henrikson
L. C. McNeill
L. J. Phillips
E. C. Sears

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary. # Treasurer.

Subcommittee on Coatings and Linings

K. W. Henderson *
T. F. Wolfe §
C. W. Beggs
L. R. Conley
P. E. Pallo
E. C. Rowley
N. Y. DuHamel Jr.‡
W. F. Fair ‡

Producers

W. E. Boswell
Arthur Roberts Jr.
E. F. Wagner
Clyde Wood

Editorial Subcommittee

H. P. Hagedorn *
L. R. Howson §
E. F. Johnson

A40.8—National Plumbing Code

American Public Health Assn.
Building Officials Conf. of America
National Assn. of Plumbing Contractors

A. T. Dempster, *AWWA Repr.*

A112—Dimensional Standardization of Plumbing Equipment

American Soc. of Mech. Engrs.
American Soc. of San. Eng.

J. G. Bradbury, *AWWA Repr.*

B2—Pipe Threads

American Gas Assn.
American Soc. of Mech. Engrs.

J. G. Bradbury, *AWWA Repr.*

B16—Standardization of Pipe Flanges and Fittings

American Soc. of Mech. Engrs.
Mfrs. Standardization Soc. of the Valve and Fittings Industry
Mech. Contractors Assn. of America

O. B. Carlisle & H. J. Chapton, *AWWA Repr.*

B16—Pipe Flanges and Fittings—Subcom. on Nonmetallic Pipe Fittings

Representatives of AWWA

F. X. Elder
Peter Ley
J. B. Ramsey

B31—Code for Pressure Piping

American Soc. of Mech. Engrs.

T. F. Wolfe, *AWWA Repr.*

B33—Hose Coupling Screw Threads

American Soc. of Mech. Engrs.

G. E. Arnold, *AWWA Repr.*

B40—Standardization of Pressure and Vacuum Gages

American Soc. of Mech. Engrs.

V. A. Appleyard, *AWWA Repr.*

B58—Vertical Turbine Pumps

American Water Works Assn.

In addition, the following organizations are cooperating in the work of this committee: American Inst. of Mining & Metallurgical Engrs.; American Public Works Assn.; American Soc. of Mech. Engrs.; Anti-Friction Bearing Mfrs. Assn.; Conf. of State San. Engrs.; New England Water Works Assn.; US Navy Dept.

M. H. Owen *
P. H. Brown §
E. B. Cobb
N. C. Ebaugh
Ray Elner
C. R. Erickson
Ed Farmer
A. D. Henderson
A. Hollander
P. J. Houser
H. W. Iverson
H. A. Knudsen
C. E. Painter
J. L. Perhab
Dan Rankin
M. J. Sassani

Producers

C. D. Bower
Don Cooper
E. C. Denne
W. L. Dornaus
A. B. Jones
T. R. Mackay
Mel Mann

B72—Plastic Pipe

American Soc. for Testing and Materials
Soc. of the Plastics Industry
American Soc. of Mech. Engrs.

J. B. Ramsey, *AWWA Repr.*

B76—Industrial Cooling Towers

Air Conditioning & Refrigeration Inst.
American Soc. of Mech. Engrs.
Cooling Tower Inst.

E. L. Knoedler Jr., *AWWA Repr.*

B78—Heat Exchangers for Chemical Industry Use

Manufacturing Chemists Assn.
Tubular Exchanger Mfrs. Assn.

E. L. Knoedler Jr., *AWWA Repr.*

K61—Storage and Handling of Anhydrous Ammonia and Ammonia Solutions

Compressed Gas Assn.

R. J. Faust, *AWWA Repr.*

Y1—Abbreviations

American Soc. of Mech. Engrs.

E. F. Johnson, *AWWA Repr.*

---

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.

Y10—Letter Symbols

American Soc. of Mech. Engrs.

W. E. Howland, *AWWA Repr.*

Y32—Graphical Symbols and Designations

American Inst. of Elec. Engrs.
American Soc. of Mech. Engrs.

R. E. Stiemke, *AWWA Repr.*

Z48—Marking of Compressed Gas Cylinders

Compressed Gas Assn.

R. J. Faust, *AWWA Repr.*

CHLORINE INSTITUTE

Public Health Advisory Com.

R. J. Faust, *AWWA Repr.*

ENGINEERS JOINT COUNCIL

Board of Directors

E. S. Cole, *AWWA Repr.*
R. J. Faust, *Alternate*

EJC Committees

Constitution and Bylaws
R. J. Faust, *AWWA Repr.*

Engineering Manpower Commission
G. E. Arnold & J. F. Daily, *AWWA Repr.*

Finance
W. J. Orchard, *AWWA Repr.*

International Relations
J. A. Frank, *AWWA Repr.*

Membership
R. J. Faust, *AWWA Repr.*

Planning
R. J. Faust, *AWWA Repr.*

Public Relations
E. F. Johnson, *AWWA Repr.*

Government Liaison
R. J. Faust, *AWWA Repr.*

Editorial Advisory—"Engineer"
E. F. Johnson, *AWWA Repr.*

Technical Advisory—"Engineer"
E. F. Johnson, *AWWA Repr.*

Computation and Information Processing Systems
J. V. Radziul, *AWWA Repr.*

Technical Planning
R. J. Faust, *AWWA Repr.*

National Water Policy Panel
J. C. Geyer, *AWWA Repr.*

Secretaries
R. J. Faust, *AWWA Repr.*

Nuclear Congress Program
E. S. Cole, *AWWA Repr.*

Who's Who in Engineering
R. J. Faust, *AWWA Repr.*

INTERNATIONAL WATER SUPPLY ASSN.

Executive Com.
Fred Merryfield, *AWWA Repr.*

NATIONAL ASSN. OF CORROSION ENGRS.

Intersociety Corrosion Com.
F. E. Dolson & Rolf Eliassen, *AWWA Repr.*

Electrical Grounding Practices
V. A. Appleyard, *AWWA Repr.*

NATIONAL FIRE PROTECTION ASSN.

Public Water Supplies for Private Fire Protection
E. A. Bell, *AWWA Repr.*

Standpipes and Outside Protection
K. J. Carl, *AWWA Repr.*

STEEL STRUCTURES PAINTING COUNCIL

J. O. Jackson, *AWWA Repr.*

US DEPT. OF INTERIOR

Saline Water Board
J. W. Cramer †

US PUBLIC HEALTH SERVICE

Informal Advisory Group to Consider Projects Related to Water Quality and Diseases

Representatives of AWWA
E. L. Bean H. E. Hudson Jr.
Oscar Gullans

* Chairman. † Ex officio. ‡ Consultant. § Co-chairman or vice-chairman. || Secretary.

AWWA PUBLICATIONS

Effective September 1, 1961

Orders should be sent to the American Water Works Association, Inc., 2 Park Ave., New York 16, N.Y. A handling charge of $1.00 will be made on all orders under $5.00 unless accompanied by remittance. All payment must be in US or Canadian funds or in AWWA Publication Discount Coupons.

BOOKS

Index to Journal AWWA (1940–55)—This cloth-bound, 192-p. book, published in 1956, includes subject, author, and geographic indexes to the JOURNAL for the 16 years from 1940 through 1955. $4.50.

Standard Methods for the Examination of Water and Wastewater. Published jointly by AWWA, American Public Health Assn. & Water Pollution Control Federation. Cloth bound, 626 pp. Eleventh edition, 1960. $10.00.

The Quest for Pure Water—By M. N. Baker. A history of water purification from the earliest records to the 20th century. 73 illustrations, 900 references, 527 pp. 1948; 2nd printing, 1949. $5.00.

Survival and Retirement Experience With Water Works Facilities—Prepared by a joint committee of the AWWA and the Institute of Water Supply Utilities. Includes reports published in installments in JOURNAL, 1945–46, with additional material and summary tables. Cloth bound, 566 pp. 1947. $3.00.

Water Quality and Treatment—Prepared by AWWA. A comprehensive survey of water quality standards and procedures for purification, softening, and other conditioning. Completely revised and enlarged second edition. 451 pp., 1950; 2nd printing, 1951. $5.00.

MANUALS

Water Rates Manual—M1—A report of the Committee on Water Rates, as published in the March 1954 JOURNAL, plus valuable supplementary data. Paper bound, 64 pp., 1960. $1.25.

Silent Service Is Not Enough!—M2—AWWA public relations study, as published in December 1954 JOURNAL, plus appendix. Paper bound, 152 pp., 1955. $1.50.

Safety Practice for Water Utilities—M3—A manual prepared by the Committee on Safety Practices and originally published serially in the JOURNAL (July–December 1955). Paper bound, 128 pp., 1960. Price, for general sales, $1.50; to members ordering quantities of 20 or more, $1.00 per copy.

Water Utility Management—M5—a manual and training course prepared by the AWWA Education Committee. Paper bound, 192 pp., 1959. Price, for general sales, $2.00; to members or schools ordering 20 or more, $1.30 per copy.

Supplementary Readings on Water Utility Management—S105—a companion to AWWA Manual M5, consisting of 26 articles from the JOURNAL. Paper bound, 192 pp., 1961. Price, for general sales, $2.00; to members or schools ordering 20 or more, $1.30 per copy.

Water Meters—M6—a manual on selection, installation, testing and maintenance prepared by the AWWA Meter Committee and originally published serially in the JOURNAL (June–September 1959). Paper bound, 88 pp., 1959. Price, for general sales, $1.25; to members or schools ordering 20 or more, $0.90 per copy.

Animals Associated With Potable Water Supplies—M7—an identification guide for operators, originally published in the December 1960 JOURNAL. Paper bound, indexed, 35 pp., 1961. Price, for general sales, $1.00; to members or schools ordering 20 copies or more, $0.75 per copy.

* Listings are revised periodically.

PERIODICALS AND PAMPHLETS

Journal American Water Works Association. A monthly magazine of technical papers, discussions, news, and reports. Issued quarterly from 1914 to 1919; bimonthly from 1920 to September 1924; monthly ever since. Annual indexes are contained in the December issue of each year from 1940 on. Cumulative indexes of authors and articles grouped by topics are described on p. 63. Subscriptions to individuals only in conjunction with AWWA membership in US, Canada, and Cuba; to individuals elsewhere, $10 per year. Single copy price (issues dated 1954 and later), 85¢; issues dated 1925–1953, 75¢; issues dated 1914–24, $1.25.

Style Manual for Journal Authors. Reprint R1011. An editorial statement specifying mechanical and style requirements for JOURNAL manuscripts and outlining publication procedure. 16 pp., 25¢.

The Story of Water Supply. A pictorial presentation designed to acquaint the junior high school student with the history, accomplishments, and workings of public water supplies. Entertaining; instructive. 16 pp., il., 15¢ (quantity prices on request). "Teaching Aids" 5¢ per copy; one free with each 50 copies of *The Story*.

What Price Water? A booklet calling attention to the real value of public water supply by comparing 1940 and current prices of water and other consumer goods, as well as water works costs. Fits No. 10 envelope. 12 pp., 10¢ per copy (quantity rates on request).

Willing Water. A monthly bulletin devoted to public relations, safety, defense, and other special problems. Usually 10¢.

Your Water Supply. A conservation guide designed as an envelope stuffer for quantity distribution. Includes "how-to" information on reading meters, detecting leaks, replacing faucet washers, saving water generally. 12 pp., il., no charge for single copies (quantity rates on request).

JOURNAL REPRINTS

Order by title and number, not by topic. Copies of Journal articles not available in reprint form can generally be obtained by ordering a copy of the issue in which they were published; for terms, see "Journal AWWA" in preceding "Periodicals and Pamphlets" section. Additional "Reprints Available" are listed in the Journal each month under that heading.

Administration. No. R903. Committee Report: Joint Administration of Water and Sewage Facilities. From June 1959 JOURNAL. 8 pp., 20¢.

Air conditioning. No. 263. Model Ordinance. Prepared by AWWA Committee on Water Use in Air Conditioning and Refrigeration. From December 1950 JOURNAL. 8 pp., 20¢.

Air conditioning. No. R803. Committee Report: Trends in Air-Conditioning Use and Regulation. From January 1958 JOURNAL. 22 pp., 35¢.

Annual reports. No. 246. Committee Report: Water Department Annual Reports. Includes a guide to the preparation of an annual statistical report. From August 1950 JOURNAL. 14 pp., 20¢.

Bonds. No. R906. F. H. Eastman: Mechanics of Bond Issue Campaigns. From September 1959 JOURNAL. 16 pp., 25¢.

Bookkeeping. No. R406. R. Newsom: Simplified System of Accounts for Average Municipal Water Works. *With* G. J. Natt: Simplified Bookkeeping System for Small Water Companies. From January 1947 and June 1949 JOURNAL. 39 pp., 70¢.

Chlorination. No. R1002. Joint Committee Report: Chlorine Supply and Use in Water and Sewage Treatment Plants (also covers alum supply). From January 1960 JOURNAL. 12 pp., 25¢.

Chlorination. No. R342. Joint Committee Report: Recommended Procedures in the Use of Chlorine at Water and Sewage Plants. From October 1953 JOURNAL. 15 pp., 25¢.

Chlorination. No. R374. Chlorine Institute: Recommended Specifications for Stationary Chlorine Storage Installations. From November 1954 JOURNAL. 12 pp., 25¢.

Corrosion. No. R817. Eliassen, Skrinde & Davis: Experimental Performance of "Miracle" Water Conditioners. From October 1958 JOURNAL. 15 pp., 25¢.

Cross connections. No. R824. Joint Committee Report: Use of Backflow Preventers for Cross-Connection Control. From December 1958 JOURNAL. 30 pp., 45¢.

Excavation. No. R612. G. F. Sowers: Trench Excavation and Backfilling. From July 1956 JOURNAL. 9 pp., 25¢.

Extensions. No. R323. Committee Reports: Water Service for Suburban Areas (from July 1953 JOURNAL), and Water Main Extension Policy (from August 1949). 39 pp., 65¢.

Filtration. No. R611. K. W. Cosens: Design and Operation Data on Large Rapid Sand Filtration Plants in the United States and Canada. From July 1956 JOURNAL. 35 pp., 60¢.

Fluoridation. No. R628. The Fluoridation of Public Water Supplies. A statement of recommended policy and procedure approved by the AWWA Board of Directors May 29, 1949, and published in the July 1949 JOURNAL. Formerly designated AWWA B700–49. 5 pp., 20¢.

Fluoridation. No. R713. Panel Discussion: Experience in Applying Fluorides. From October 1957 JOURNAL. 40 pp., 55¢.

Fluoridation. No. R320. W. W. Land & E. K. Mosenthal. Court Decisions on Municipal Water Fluoridation. From April 1953 JOURNAL. 10 pp., 25¢.

Fluoridation. No. R819 Conway: Legal Aspects of Municipal Fluoridation. From October 1958 JOURNAL. 8 pp., 20¢.

Fluoridation. No. R907. W. T. Ingram & G. W. Moore: Fluoridation in Major Cities of the United States. From September 1959 JOURNAL. 16 pp., 25¢.

Fluoridation. No. R1019. Task Group Report: Status of Fluoridation in the United States and Canada, 1959. From December 1960 JOURNAL. 8 pp., 20¢.

Fluoridation. No. R814. Joint Discussion: Availability of Fluoridation Chemicals. *With* Staff Report: Survey of Fluoride Availability. From August 1958 JOURNAL. 10 pp., 25¢.

Ground water. No. R404. Brown: Selected Procedures for Analyzing Aquifer Test Data. From August 1953 JOURNAL. 24 pp., 40¢.

Grounding. No. 270. AWWA Policy Statement: Grounding of Electric Circuits on Water Pipe. *Also* C. F. Meyerherm: Water Works Industry's Attitude on Grounding and Stray Current Problems. From April 1944 and December 1945 JOURNALS. 4 pp., 10¢.

Hydraulics. No. R805. Committee Report: Water Hammer Allowances in Pipe Design. From March 1958 JOURNAL. 16 pp., 25¢.

Operation. No. 370. Panel Discussion: Fundamentals of Water Works Operation. From October 1954 JOURNAL. 15 pp., 25¢.

Pipe, cast iron. No. 359. Historical edition of "1908 Cast-Iron Pipe Specifications." From July 1954 JOURNAL. 12 pp., 25¢.

Pipe, plastic. No. R821. Symposium: Plastic Pipe in Distribution Systems. From November 1958 JOURNAL. 16 pp., 25¢.

Pipe, plastic. No. R1015. R. J. Sweitzer: Developments in Plastics and Plastic Pipe. From October 1960 JOURNAL. 12 pp., 25¢.

Pipe, steel. No. R601. G. E. Burnett & P. W. Lewis: New Developments in Tests of Coatings and Wrappings. From February 1956 JOURNAL. 22 pp., 35¢.

Pipeline breaks. No. R1013. Panel Discussion: Experience With Main Breaks in Four Large Cities. From August 1960 JOURNAL. 18 pp., 30¢.

Pollution. No. R1016. R. L. Woodward: Significance of Pesticides in Water Supplies. From November 1960 JOURNAL. 6 pp., 20¢.

Regulations. No. R802. W. C. Welmon: Service Rules and Standards for California Water Utilities [including California Public Utilities Commission Rules Governing Water Service]. From January 1958 JOURNAL. 22 pp., 35¢.

Resources. No. R706. Committee Report (with Preamble by Abel Wolman): Basic

Principles of a National Water Resources Policy. From July 1957 JOURNAL. 9 pp., 25¢.

Salaries. No. R914. Committee Report: Survey on Compensation of Water Utility Managers. From December 1959 JOURNAL. 30 pp., 45¢.

Saline water. No. R102. Abel Wolman: Impact of Desalinization on the Water Economy. From February 1961 JOURNAL. 6 pp., 20¢.

Statistics. A Survey of Operating Data for Water Works in 1955. From May 1957 JOURNAL. No. R704, 144 pp., 75¢. In combination with statistical analysis by Seidel & Baumann plus R. Porges' summary of 1955 USPHS survey of treatment facilities, from December 1957 JOURNAL—No. R722, 194 pp., $1.25. The Seidel-Baumann and Porges analyses (without the operating data survey tables)—No. R723, 50 pp., 60¢.

Statistics. No. R101. K. H. Jenkins: 1958 Inventory of Water Supply Facilities in United States Communities With Populations of 25,000 or More. From January 1961 JOURNAL. 8 pp., 20¢.

Statistics. No. R820. Task Group Report: Study of Domestic Water Use. From November 1958 JOURNAL. 12 pp., 25¢.

Storage. No. R343. Committee Report: Potable-Water Storage Reservoirs. From October 1953 JOURNAL. 11 pp., 25¢.

Synthetic detergents. No. R361. Task Group Report: Characteristics and Effects of Synthetic Detergents. From August 1954 JOURNAL. 24 pp., 60¢.

Training. No. 340. Committee Report: Status of Training Courses and Certification in the United States. From September 1953 JOURNAL. 26 pp., 40¢.

Treatment. No. R402. Revision of aeration and mixing and sedimentation chapters of *Water Quality and Treatment.* From August and September 1956 JOURNAL. 36 pp., 60¢.

Unaccounted-for water. No. R724. Committee Report: Revenue-Producing Versus Unaccounted-for Water. From December 1957 JOURNAL. 6 pp., 20¢.

Valves. No. 372. L. Paul: Selection of Valves for Water Works Service. From November 1954 JOURNAL. 20 pp., 30¢.

AWWA STANDARDS

Explanation of designation system: AWWA standard designations consist of two elements separated by a dash; e.g., B224–52T. This would designate a standard in the B200 series (dealing with softening) which was approved (or last revised) as Tentative in 1952. If this document had been made Standard (with or without revision) in 1957, the designation would have become: B224–57. When such a change in status is accompanied by no revisions, or only very minor ones, the new designation is listed, but standards bearing the earlier designation continue to be furnished by AWWA until existing stocks are exhausted.

A—Source

A100–58—AWWA Standard for Deep Wells. Approved as Tentative Apr. 30, 1945, and published in the September 1945 JOURNAL. Made Standard May 10, 1946; latest revision Jan. 26, 1958. 55 pp., 75¢.

A101–60 (ASA B58.1–1961)—American Standard for Vertical Turbine Pumps. Revised edition approved by the American Standards Assn. Jan. 31, 1961, and published in the March 1961 JOURNAL. 38 pp., 80¢.

B—Treatment

B100—Filtration

B100–53—AWWA Standard for Filtering Material. Revision of 1943 document approved as Tentative Nov. 15, 1948, and published in the March 1949 JOURNAL. Made Standard Jan. 16, 1950. Revised Jun. 2, 1953. 16 pp., 25¢

B200—Softening

B200–53—AWWA Standard for Sodium Chloride. Approved as Tentative Jul. 6, 1949, and published in the March 1950 JOURNAL. Made Standard May 15, 1953. 10 pp., 25¢.

B201–59—AWWA Standard for Soda Ash. Approved as Tentative Oct. 15, 1951, and published in the February 1952 JOURNAL. Made Standard May 15, 1953. Latest revision Jan. 26, 1959. 6 pp., 20¢.

B202–54—AWWA Standard for Quicklime and Hydrated Lime. Approved as Tentative Sep. 9, 1952, and published in the January 1953 JOURNAL. Made Standard May 27, 1954. 14 pp., 25¢.

B250–51—AWWA Standard for Cation Exchanger Test Procedures. Revision of 1943 document approved as Tentative Dec. 31, 1948, and published in the May 1949 JOURNAL. Made Standard May 4, 1951. 28 pp., 40¢.

B300—Disinfection

B300–55—AWWA Standard for Hypochlorites. Approved as Tentative Jun. 2, 1953, and published in the October 1953 JOURNAL. Made Standard Jun. 17, 1955. 6 pp., 20¢.

B301–59—AWWA Standard for Liquid Chlorine. Approved as Tentative Oct. 17, 1957, and published in the February 1958 JOURNAL. Made Standard without revision Jan. 26, 1959. 6 pp., 20¢.

B400—Coagulation

B400–53—AWWA Standard for Ammonium Sulfate. Approved as Tentative Jul. 15, 1949, and published in the November 1950 JOURNAL. Made Standard May 15, 1953. 7 pp., 20¢.

B401–53—AWWA Standard for Bauxite. Approved as Tentative Apr. 28, 1950, and published in the July 1950 JOURNAL. Made Standard May 15, 1953. 8 pp., 20¢.

B402–53—AWWA Standard for Ferrous Sulfate. Approved as Tentative May 31, 1949, and published in the October 1950 JOURNAL. Made Standard May 15, 1953. 7 pp., 20¢.

B403–58—AWWA Standard for Aluminum Sulfate. Approved as Tentative Aug. 21, 1952, and published in the November 1952 JOURNAL. Made Standard May 27, 1954. Latest revision Jan. 26, 1958. 10 pp., 25¢.

B404–58—AWWA Standard for Liquid Sodium Silicate. Approved as Tentative Aug. 5, 1955, and published in the October 1955 JOURNAL. Made Standard without revision Jan. 26, 1958. 7 pp., 20¢.

B405–60—AWWA Standard for Sodium Aluminate. Approved as Tentative Jan. 26, 1959, and published in the June 1959 JOURNAL. Made Standard May 15, 1960. 8 pp., 20¢.

B406–61T—Tentative AWWA Standard for Ferric Sulfate. Approved as Tentative Jan. 23, 1961, and published in the May 1961 JOURNAL. 7 pp., 20¢.

B500—Scale and Corrosion Control

B500–53—AWWA Standard for Trisodium Phosphate. Approved as Tentative Apr. 3, 1950, and published in the June 1950 JOURNAL. Made Standard May 15, 1953. 6 pp., 20¢.

B501–53—AWWA Standard for Caustic Soda. Approved as Tentative Oct. 15, 1951, and published in the December 1951 JOURNAL. Made Standard May 15, 1953. 6 pp., 20¢.

B600—Taste and Odor Control

B600–53—AWWA Standard for Powdered Activated Carbon. Approved as Tentative Jul. 11, 1949, and published in the February 1951 JOURNAL. Made Standard May 15, 1953. 14 pp., 25¢.

B601–55—AWWA Standard for Sodium Pyrosulfite. Approved as Tentative Dec. 18, 1953, and published in the January 1954 JOURNAL. Made Standard without revision Jun. 17, 1955. 5 pp., 20¢.

B602–59—AWWA Standard for Copper Sulfate. Approved as Tentative Sep. 15, 1957, and published in the January 1958 JOURNAL. Made Standard without revision Jan. 26, 1959. [*B602–57T current.**] 8 pp., 20¢.

B700—Prophylaxis

B701–60—AWWA Standard for Sodium Fluoride. Second edition approved May 15, 1960, and published in the January 1961 JOURNAL. 7 pp., 20¢.

B702–60—AWWA Standard for Sodium Silicofluoride. Second edition approved May 15, 1960, and published in the January 1961 JOURNAL. 7 pp., 20¢.

B703–60—AWWA Standard for Fluosilicic Acid. Second edition approved May 15, 1960, and published in the January 1961 JOURNAL. 7 pp., 20¢.

* See explanation of designation system, p. 66.

C—Distribution

C100—Cast-Iron Pipe, Fittings

C100–55—AWWA Standard for Cast-Iron Pressure Fittings. The "special castings" portion of the original 1908 standards for cast-iron pipe and castings; still valid for replacing old fittings, but superseded by various American Standards (which follow) for new installations. Third edition approved as Tentative Oct. 25, 1954. Made Standard Jun. 17, 1955. 30 pp., 55¢.

C101–57 (ASA A21.1–1957)—American Standard Practice Manual for the Computation of Strength and Thickness of Cast Iron Pipe. Adopted by AWWA and the American Standards Assn. December 1939 and published in the December 1939 JOURNAL. Revised 1957. 172 pp., $1.50.

C102–53 (ASA A21.2–1953)—American Standard for Cast Iron Pit Cast Pipe for Water or Other Liquids. Adopted by AWWA and the American Standards Assn. December 1939 and published in the December 1939 JOURNAL. Latest revision Jan. 13, 1953. 23 pp., 45¢.

C104–53 (ASA A21.4–1953)—American Standard for Cement-Mortar Lining for Cast Iron Pipe and Fittings. Adopted by AWWA and the American Standards Assn. December 1939 and published in the December 1939 JOURNAL. Latest revision Jan. 13, 1953. 5 pp., 35¢.

C106–53 (ASA A21.6–1953)—American Standard for Cast Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids. Adopted by AWWA and the American Standards Assn. Jan. 13, 1953, and published in the February 1953 JOURNAL. 20 pp., 40¢. *Revision pending.*

C108–53 (ASA A21.8–1953)—American Standard for Cast Iron Pipe Centrifugally Cast in Sand-lined Molds, for Water or Other Liquids. Adopted by AWWA and the American Standards Assn. Jan. 13, 1953, and published in the February 1953 JOURNAL. 24 pp., 45¢. *Revision pending.*

C110–52 (ASA A21.10–1952)—American Standard for Short-Body Cast Iron Fittings, 3 Inch to 12 Inch, for 250-psi Water Pressure Plus Water Hammer. Adopted by AWWA and the American Standards Assn. Sep. 30, 1952, and published in the November 1952 JOURNAL. 10 pp., 35¢.

C111–53 (ASA A21.11–1953)—American Standard for a Mechanical Joint for Cast Iron Pressure Pipe and Fittings. Adopted by AWWA and the American Standards Assn. Jan. 13, 1953, and published in the April 1953 JOURNAL. 12 pp., 35¢.

C200—Steel Pipe

C201–60T—Tentative AWWA Standard for Fabricated Electrically Welded Steel Pipe. Second edition approved as Tentative May 15, 1960, and published in the November 1960 JOURNAL. 20 pp., 30¢.

C202–60T—Tentative AWWA Standard for Mill-Type Steel Water Pipe. Second edition approved as Tentative May 15, 1960, and published in the November 1960 JOURNAL. 24 pp., 40¢.

[Note: The second edition of each of the above two standards covers the entire range of sizes for the kind of pipe indicated; in the first editions, which are now superseded, C201 covered large pipe and C202 covered small pipe.]

C203–57—AWWA Standard for Coal-Tar Enamel Protective Coatings for Steel Water Pipe. Second edition, superseding *both* C203–55 and C204–55, approved Mar. 27, 1957, and published in the July 1957 JOURNAL. 28 pp., 45¢.

C205–41—AWWA Standard for Cement-Mortar Protective Coatings for Steel Water Pipe of Sizes 30 Inches and Over. Published as Tentative in the January 1940 JOURNAL and made Standard Jun. 26, 1941. 16 pp., 25¢.

C206–57—AWWA Standard for Field Welding of Steel Water Pipe Joints. Approved as Tentative Jan. 10, 1946, and published in the March 1946 JOURNAL. Made Standard Nov. 27, 1950. Latest revision Jan. 22, 1957. 12 pp., 25¢.

C207–55—AWWA Standard for Steel Pipe Flanges. Approved as Tentative May 9, 1952, and published in the October 1952 JOURNAL. Made Standard Jun. 17, 1955. 8 pp., 20¢.

* See explanation of designation system, p. 66.

C208–59—AWWA Standard for Dimensions for Steel Water Pipe Fittings. Approved as Tentative Jul. 14, 1955, and published in the July 1956 JOURNAL. Made Standard Jan. 26, 1959. 12 pp., 25¢.

C300—Concrete Pipe

C300–57—AWWA Standard for Reinforced Concrete Water Pipe—Steel Cylinder Type, Not Prestressed. Approved as Tentative Dec. 11, 1947, and published in the March 1948 JOURNAL. Made Standard Jun. 13, 1952. Latest revision Jul. 19, 1957. 15 pp., 25¢.

C301–58—AWWA Standard for Reinforced Concrete Water Pipe—Steel Cylinder Type, Prestressed. Second edition approved as Tentative Jun. 17, 1955. Made Standard without revision Jan. 26, 1958. 18 pp., 30¢.

C302–57—AWWA Standard for Reinforced Concrete Water Pipe—Noncylinder Type, Not Prestressed. Approved as Tentative Sep. 4, 1951, and published in the October 1951 JOURNAL. Made Standard May 15, 1953. Latest revision Jul. 19, 1957. 16 pp., 25¢.

C400—Asbestos-Cement Pipe

C400–53T—Tentative AWWA Standard for Asbestos-Cement Water Pipe. Approved as Tentative May 15, 1953, and published in the July 1953 JOURNAL. 8 pp., 20¢. *Revision pending.*

C500—Valves and Hydrants

C500–61—AWWA Standard for Gate Valves for Ordinary Water Works Service. Second edition approved Jan. 28, 1959, and published in the July 1959 JOURNAL. Made Standard Jan. 23, 1961. 16 pp., 25¢.

C501–41T—Tentative AWWA Standard for Sluice Gates. Approved as Tentative Jun. 26, 1941, and published in the October 1941 JOURNAL. 11 pp., 25¢.

C502–54—AWWA Standard for Fire Hydrants for Ordinary Water Works Service. Revision of 1940 document approved Mar. 16, 1953, and published in the May 1953 JOURNAL. Made Standard May 27, 1954. 12 pp., 25¢. *Revision pending.*

C503–59—AWWA Standard for Wet-Barrel Fire Hydrants for Ordinary Water Works Service. Approved as Tentative Jan. 26, 1958, and published in the August 1958 JOURNAL. Made Standard without revision Jul. 17, 1959. [*C503–58T current.**] 10 pp., 25¢. [Note: The uniform color scheme for fire hydrants, formerly designated C503–37 and printed under the same cover as C502, is now incorporated (as "Appendix B") in both C502 and the new C503.]

C504–58—AWWA Standard for Rubber-seated Butterfly Valves. Approved as Tentative May 27, 1954, and published in the September 1954 JOURNAL. Made Standard Jan. 26, 1958 (including revisions approved Sep. 16, 1957). 16 pp., 25¢.

C505–58—AWWA Standard for Metal-seated Butterfly Valves. Approved as Tentative Nov. 10, 1955, and published in the February 1956 JOURNAL. Made Standard Jan. 26, 1958 (including revisions approved Sep. 16, 1957). 16 pp., 25¢.

C600—Pipelaying

C600—54T—Tentative AWWA Standard for Installation of Cast-Iron Water Mains. Revision of 1938 document approved as Tentative Jun. 3, 1949, and published in the December 1949 JOURNAL. Revised May 27, 1954. 33 pp., 50¢.

C601–54—AWWA Standard for Disinfecting Water Mains. Revision of 1947 document approved as Tentative Mar. 6, 1953, and published in the August 1953 JOURNAL. Reprinted together with commentary, "Revised Main Disinfection Procedure," by Marshall P. Crabill. Made Standard May 27, 1954. 12 pp., 25¢.

C602–55—AWWA Standard for Cement-Mortar Lining of Water Pipelines in Place—Sizes 16 Inches and Over. Approved as Tentative May 27, 1954, and published in the October 1954 JOURNAL. Made Standard without revision Jun. 17, 1955. 8 pp., 20¢.

C700—Meters

C700–61T—Tentative AWWA Standard for Cold-Water Meters—Displacement Type. Second edition approved as Tentative Jan. 23, 1961, and published in the July 1961 JOURNAL. 13 pp., 25¢.

* See explanation of designation system, p. 66.

C701–47—AWWA Standard for Cold Water Meters—Current Type. Published as Tentative in the April 1946 JOURNAL and made Standard Jul. 25, 1947. 12 pp., 25¢.

C702–47—AWWA Standard for Cold Water Meters—Compound Type. Published as Tentative in the April 1946 JOURNAL and made Standard Jul. 25, 1947. 11 pp., 25¢.

C703–49—AWWA Standard for Cold Water Meters—Fire Service Type. Published as Tentative in the February 1947 JOURNAL and made Standard Jan. 18, 1949. 12 pp., 25¢.

C704–50—AWWA Standard for Cold Water Meters—Current Type—Propeller Driven. Approved as Tentative Jul. 21, 1949, and published in the August 1949 JOURNAL. Made Standard May 25, 1950. 12 pp., 25¢.

C705–60—AWWA Standard for Testing Cold-Water Meters. Published in the June 1956 issue of *Willing Water* as a committee report. Approved as Tentative Jan. 28, 1957. Made Standard without revision May 20, 1960. 6 pp., 20¢.

C800—Service Lines

C800–55—AWWA Standard for Threads for Underground Service Line Fittings. Approved as Tentative Jul. 25, 1947, and published in the October 1947 JOURNAL. Made Standard Sep. 15, 1948. Revised Jan. 17, 1955. Included under same cover is "Collected Standards for Service Line Materials," a committee report. 15 pp., 25¢.

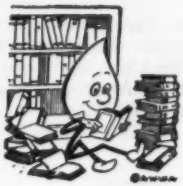
D—Storage

D100–59—AWWA Standard for Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks, for Water Storage. Latest revision Jan. 26, 1959. Combined with AWWA D102, description of which appears below, in a single booklet. 72 pp., 80¢.

D101–53—AWWA Standard for Inspecting and Repairing Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks, for Water Storage. Revision of 1949 document approved May 9, 1952. Combined with AWWA D102, description of which appears below, in a single booklet. Made Standard May 15, 1953. 32 pp., 50¢.

D102–55T—Tentative AWWA Standard for Painting and Repainting Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks, for Water Storage. Approved by AWWA as Tentative May 9, 1952, and published in the August 1952 JOURNAL. Available only in combination with AWWA D100 or AWWA D101, prices of which are given above. Last revised Aug. 5, 1955. *Revision pending.*

* See explanation of designation system, p. 66.



The Water Supply Library

The list of books that follows is not intended as a complete bibliography on water supply. It is merely a checklist of certain selected books, currently available, which have been found useful and valuable to the field. Books may be obtained from the publisher or through local booksellers. AWWA does not undertake to accept orders for any books but those published by it. For the purchaser's information, the complete address of every publisher represented in the list is given on page 80. The prices given were current at the time the list was compiled, but are subject to subsequent change. Some of the professional organizations offer discounts on the list prices of books they publish to their own members; only list prices are given below. A separate and complete list of AWWA publications may be obtained on request.

GENERAL

Bibliography and Reference

Annotated Bibliography on Hydrology, United States and Canada. 1941–50, $1.75; 1951–54, $1.25. American Geophysical Union (1952, 1955) [distributed by Government Printing Office]

Bibliographic Survey of Corrosion. National Assn. of Corrosion Engineers (1945, $5; 1946–47, $9; 1948–49, $12.50; 1950–51, $12.50; 1952–53, $12.50; 1954–55, $20; 1956, $27.50)

Bibliography of Publications Relating to Ground Water Prepared by the Geological Survey and Cooperating Agencies, 1946–55. R. C. Vorhis, ed. Water Supply Paper 1492, Geological Survey (1957) 60¢ [distributed by Government Printing Office]

A Glossary of Terms in Nuclear Science and Technology. American Society of Mechanical Engineers (1957) $5

Glossary—Water and Sewage Control Engineering. American Society of Civil Engineers (1949) $2

Handbook of Material Trade Names. O. T. Zimmerman & Irvin Lavine. Industrial Research Service (2nd ed., 1953) $22; *Supplement I* (1956) $13.75; *Supplement II* (1957) $15; *Supplement III* (1960) $16

Index to Journal American Water Works Association, 1940–1955. American Water Works Assn. (1956) $4.50

Index to "Sewage and Industrial Wastes," 1949–1958. Water Pollution Control Federation (1959) $4

Publications of the Geological Survey. Geological Survey (1958; periodic supplements) free

Source Materials on Water Pollution Control. Pub. 243, Public Health Service (1958) free

Popular and Historical

BAKER, M. N. *The Quest for Pure Water.* American Water Works Assn. (1948) $5

BLAKE, NELSON M. *Water for the Cities.* Syracuse Univ. Press (1956) $4

DALEY, ROBERT. *The World Beneath the City.* J. B. Lippincott Co. (1960) $3.95

DRAFFIN, JASPER OWEN. *The Story of Man's Quest for Water.* Garrard Press (1939) $2

FRONTINUS, SEXTUS JULIUS. *The Aqueducts of Rome.* Charles E. Bennett & Mary B. McElwain revision of Clemens Herschel translation; also Latin original

(c. 97 A.D.). Includes text of *The Strategems.* Loeb Classical Library, Harvard Univ. Press (English ed., 1925) $3.50

KING, THOMSON. *Water—Miracle of Nature.* Macmillan Co. (1953) $3.75

LEOPOLD, LUNA B. & LANGBEIN, WALTER B. *A Primer on Water.* Geological Survey (1960) $0.35 [distributed by Government Printing Office]

The Story of Water Supply: A trip behind your water faucet. American Water Works Assn. (1954) 15¢

What Price Water? American Water Works Assn. (1957) 10¢

WATER RESOURCES

Conservation and Water Policy

CARHART, ARTHUR H. *Water—or Your Life.* J. B. Lippincott Co. (1951) $4.50

COLMAN, E. A. *Vegetation and Watershed Management.* Ronald Press Co. (1953) $8

Conservation of Natural Resources. Guy-Harold Smith, ed. John Wiley & Sons (2nd ed., 1958) $8.50

ELLIS, C. B. *Fresh Water From the Ocean.* Ronald Press Co. (1954) $6

Forestry Handbook. Reginald D. Forbes, ed. Ronald Press Co. (1955) $15

HIRSHLEIFER, JACK; DEHAVEN, JAMES C.; & MILLIMAN, JEROME W. *Water Supply Economics, Technology, and Policy.* Univ. of Chicago Press (1960) $7.50

KERR, ROBERT S. *Land, Wood and Water.* Fleet Publishing Corp. (1960) $4.75

KREIGER, R. A.; HATCHETT, J. L.; & POOLE, J. L. *Preliminary Survey of the Saline-Water Resources of the United States.* Water Supply Paper 1374, Geological Survey (1957) $1 [distributed by Government Printing Office]

LANGBEIN, WALTER B. & HOYT, WILLIAM G. *Water Facts for the Nation's Future.* Ronald Press Co. (1959) $5

MACKICHAN, KENNETH A. *Estimated Use of Water in the United States, 1955.* Circular 398, Geological Survey (1957) free

MARTIN, ROSCOE C., ET AL. *River Basin Administration and the Delaware.* Syracuse Univ. Press (1960) $5

Saline Water Conversion Report, 1960. Office of Saline Water (1961) free

Your Water Supply. American Water Works Assn. (1953) single copies free

Hydrology and Surface Waters

BUTLER, STANLEY S. *Engineering Hydrology.* Prentice-Hall (1957) $9.35

FOSTER, EDGAR E. *Rainfall and Runoff.* Macmillan Co. (1948) $12

HOYT, WILLIAM G. & LANGBEIN, WALTER B. *Floods.* Princeton Univ. Press (1955) $7.50

Hydrology. Oscar E. Meinzer, ed. Dover Publications (1942; reprinted 1949) $2.95

JOHNSTONE, DON & CROSS, WILLIAM P. *Elements of Applied Hydrology.* Ronald Press Co. (1949) $6

LINSLEY, RAY K., JR.; KOHLER, MAX A.; & PAULHUS, JOSEPH L. H. *Hydrology for Engineers.* McGraw-Hill Book Co. (1958) $8.50

WISLER, CHESTER O. & BRATER, E. F. *Hydrology.* John Wiley & Sons (2nd ed., 1959) $9.25

Regional Water Resources

The Industrial Utility of Public Water Supplies in the United States, 1952. Geological Survey (1954). *Part 1—States East of the Mississippi River* (Water Supply Paper 1299) $2.25; *Part 2—States West of the Mississippi River* (Water Supply Paper 1300) $1.75 [distributed by Government Printing Office]

Inventory of Published and Unpublished Chemical Analyses of Surface Water in Eastern United States. Bul. 6, Subcommittee on Hydrology, Federal Inter-Agency River Basin Committee (1954) 50¢ [distributed by Government Printing Office]

Inventory of Published and Unpublished Chemical Analyses of Surface Water in Western United States, 1947–55. Bul. 9, Subcommittee on Hydrology, Federal Inter-Agency River Basin Committee (1956) 60¢ [distributed by Government Printing Office]

Quality of Surface Waters of the United States. Geological Survey [continuing reports of chemical analyses at sampling points, issued as regional Water Supply

Papers *] variously priced [distributed by Government Printing Office]

Surface Water Supply of the United States. Geological Survey [annual reports on water flow and level at gaging stations, issued as 18 regional Water Supply Papers *] variously priced [distributed by Government Printing Office]

Ground Water

ANDERSON, KEITH. *Water Well Handbook.* Missouri Water Well Drillers Assn. (9th printing, 1957) $2.50

BENNISON, E. W. *Ground Water: Its Development, Uses, and Conservation.* Edward E. Johnson (1947) $3.25

MCGUINNESS, C. L. *Water Law With Special Reference to Ground Water.* Circular 117, Geological Survey (1951) free

MEINZER, O. E. *The Occurrence of Ground Water in the United States, With a Discussion of Principles.* Water Supply Paper 489, Geological Survey (1923; reprinted 1948) $3 [distributed by Government Printing Office]

TODD, DAVID K. *Ground Water Hydrology.* John Wiley & Sons (1959) $10.75

TOLMAN, C. F. *Ground Water.* McGraw-Hill Book Co. (1937) $11

Water Levels and Artesian Pressures in Observation Wells in the United States. Geological Survey [annual reports issued as regional Water Supply Papers *] variously priced [distributed by Government Printing Office]

WATER QUALITY

Aquatic Life

Animals Associated With Potable Water Supplies: Operators' Identification Guide [AWWA Manual M7]. American Water Works Assn. (1961) $1

PALMER, C. MERWIN. *Algae in Water Supplies.* Pub. 657, Public Health Service (1959) $1 [distributed by Government Printing Office]

TIFFANY, LEWIS HANFORD & BRITTON, MAX EDWIN. *The Algae of Illinois.* Univ. of Chicago Press (1952) $10

Ward and Whipple's Fresh-Water Biology. W. T. Edmondson, ed. John Wiley & Sons (2nd ed., 1959) $34.50

WELCH, PAUL S. *Limnological Methods.* McGraw-Hill Book Co. (1948) $9

Bacterial and Chemical Analysis

Bergey's Manual of Determinative Bacteriology. Robert S. Breed et al., ed. Williams & Wilkins Co. (7th ed., 1957) $15

COX, CHARLES R. *Laboratory Control of Water Purification.* Case-Shepperd-Mann Dept., Business Papers Div., Reuben H. Donnelley Corp. (1946) $4

GAINEY, P. L. & LORD, THOMAS H. *Microbiology of Water and Sewage.* Prentice-Hall (1952) $9.35; Laboratory Manual, $2.25

Manual on Industrial Water. Special Technical Pub. 148E, American Society for Testing and Materials (2nd ed., 2nd printing, 1960) $11

The Merck Index of Chemicals and Drugs. Merck & Co. (7th ed., 1960) $12

PRESCOTT, SAMUEL CATE; WINSLOW, CHARLES-EDWARD AMORY; & MCCRADY, MAC HARVEY. *Water Bacteriology.* John Wiley & Sons (6th ed., 1946) $5.25

RAINWATER, F. H. & THATCHER, L. L. *Methods for Collection and Analysis of Water Samples.* Water Supply Paper 1454, Geological Survey (1960) $1.50 [distributed by Government Printing Office]

Standard Methods for the Examination of Water and Wastewater. American Public Health Assn., American Water Works Assn., and Water Pollution Control Federation (11th ed., 1960) $10 [distributed by American Public Health Assn.]

TAYLOR, EDWIN WINDLE. *The Examination of Waters and Water Supplies.* (7th ed., 1958) $18.50 [published in Great Britain; distributed in US by Little, Brown & Co.]

THEROUX, FRANK R.; ELDRIDGE, EDWARD F.; & MALLMANN, W. LEROY. *Laboratory Manual for Chemical and Bacterial Analysis of Water and Sewage.* McGraw-Hill Book Co. (3rd ed., 1943) $5.75

---

* Details given in *Publications of the Geological Survey* noted on p. 71 above. Additional studies have been published by certain state agencies.

Water Meter Manual

Essential information on cold-water meter selection, installation, testing, and maintenance is presented by the AWWA Meter Committee in clear, concise language, generously amplified by photos, drawings, and tables. Meets a long-felt need for a practical guide in this field. AWWA Manual M6, paperbound, 88 pp.

Price, $1.25

Order from:

AMERICAN WATER WORKS ASSOCIATION
2 Park Ave., New York 16, N.Y.

Zinsser: Microbiology. David T. Smith, Norman F. Conant & D. Gordon Sharp, ed. Appleton-Century-Crofts (12th ed., 1960) $13

Public Health

BABBITT, HAROLD E. *Engineering in Public Health.* McGraw-Hill Book Co. (1952) $10.50

EHLERS, VICTOR M. & STEEL, ERNEST W. *Municipal and Rural Sanitation.* McGraw-Hill Book Co. (5th ed., 1958) $9.75

Fluoridation Information Materials Kit. American Dental Assn. (revised periodically) $1

HOPKINS, EDWARD S. & SCHULZE, WILMER H. *The Practice of Sanitation.* Williams & Wilkins Co. (3rd ed., 1958) $8

PHELPS, EARLE B. *Public Health Engineering,* Vol. 1. John Wiley & Sons (1948) $8.50.

Recommended Practice for Design, Equipment, and Operation of Swimming Pools and Other Public Bathing Places. American Public Health Assn. (10th ed., 1957) $1

SALVATO, JOSEPH A., JR. *Environmental Sanitation.* John Wiley & Sons (1958) $12

WRIGHT, FORREST B. *Rural Water Supply and Sanitation.* John Wiley & Sons (2nd ed., 1956) $4.96

Pollution and Sewage Treatment

BABBITT, HAROLD E. & BAUMANN, E. ROBERT. *Sewerage and Sewage Treatment.* John Wiley & Sons (8th ed., 1958) $10.75

BESSELIEVRE, EDMUND B. *Industrial Waste Treatment.* McGraw-Hill Book Co. (1952) $9

Facts About the Federal Water Pollution Control Act of 1956. Pub. 555, Public Health Service (1957) free

HARDENBERGH, WILLIAM A. *Sewerage and Sewage Treatment.* International Textbook Co. (3rd ed., 1950) $7.25

IMHOFF, KARL & FAIR, GORDON M. *Sewage Treatment.* John Wiley & Sons (2nd ed. 1956) $7.50

KLEIN, LEWIS *Aspects of River Pollution.* Academic Press (1957) $14.50

Manual for Sewage Plant Operators. Texas Water & Sewage Works Assn. (2nd ed., 1955) $6.50

Manuals of Sewage and Industrial Wastes Practice. Water Pollution Control Federation. No. 1—*Safety in Wastewater Works* (1959) $1.50; No. 2—*Utilization of Sewage Sludge as Fertilizer* (1946) $1.25; No. 4—*Chlorination of Sewage and Industrial Wastes* (1951) $1.25; No. 5—*Air Diffusion in Sewage Works* (1952) $1.25; No. 6—*Units of Expression for Wastes and Wastes Treatment* (1958) 50¢; No. 7—*Sewer Maintenance* (1960) $1.50; No. 8—*Sewage Treatment Plant Design* (1959) $7; No. 9—*Design and Construction of Sanitary and Storm Sewers* (1960) $7

Municipal and Industrial Waste Facilities—1957 Inventory. Pub. 622, Public Health Service (1958). 9 vols. (by regions), $10.25 [distributed by Government Printing Office]

TECHNICAL PRACTICE

Treatment

Chlorine Manual. The Chlorine Institute (3rd ed., 1959) $0.50

Drinking Water Standards of the US Public Health Service. Reprint R111, American Water Works Assn. (1961) $0.25

FAIR, GORDON M. & GEYER, JOHN C. *Water Supply and Waste Water Disposal.* John Wiley & Sons (1954) $16

GOLDMAN, LOUIS. *Boiler Water Treatment Manual for Federal Plant Operators.* Handbook 5, Bureau of Mines (1951) 50¢ [distributed by Government Printing Office]

HARDENBERGH, W. A. & RODIE, E. B. *Water Supply and Waste Disposal.* International Textbook Co. (1961) $11

Hoover's Water Supply and Treatment. Revised by Merrill L. Riehl. National Lime Assn. (1957) $2

Manual on Industrial Water. Special Technical Pub. 148E, American Society for Testing and Materials (2nd ed., 2nd printing, 1960) $11

Manual of Recommended Water Sanitation Practice. Pub. 525, Public Health Service (1958) 20¢ [distributed by Government Printing Office]

Municipal Water Facilities—Communities of 25,000 Population and Over. Public Health Service (issued periodically) free

Municipal Water Facilities Inventory as of January 1, 1958. Pub. 775, US Public Health Service (1960–61). Region I (New England), $0.50; Region II (Del., N.J., N.Y., Pa.), $0.75; Region III (D.C., Ky., N.C., Va., W.Va., P.R., V.I.), $0.65; Region IV (Ala., Fla., Ga., Miss., S.C., Tenn.), $0.60; Region V (Ill., Ind., Mich., Ohio, Wis.), $0.70; Region VI (Iowa, Kan., Minn., Mo., Neb., N.D., S.D.), $0.70; Region VII (Ark., La., N.M., Okla., Tex.), $0.60; Region VIII (Colo., Idaho, Mont., Utah, Wyo.), $0.40; Region IX (Ariz., Calif., Nev., Ore., Wash., Alaska, Hawaii), $0.60 [distributed by Government Printing Office]

NORDELL, ESKEL. *Water Treatment for Industrial and Other Uses.* Reinhold Pub. Corp. (2nd ed., 1961) $12

POWELL, SHEPPARD T. *Water Conditioning for Industry.* McGraw-Hill Book Co. (1954) $12

RUDOLFS, WILLEM. *Lime: Handling, Storage, and Application.* National Lime Assn. (1949) single copies free

Water Quality and Treatment: A manual. American Water Works Assn. (2nd ed., 1951) $5

Water Works Operation

BABBITT, HAROLD E. & DOLAND, JAMES J. *Water Supply Engineering.* McGraw-Hill Book Co. (5th ed., 1955) $9.50

Basic Water Works Manual. Robert J. Sweitzer, ed. American Concrete Pressure Pipe Assn. (1958) free to water utility personnel

KRISTAL, FRANK A. & ANNETT, F. A. *Pumps:* Types, selection, installation, operation, and maintenance. McGraw-Hill Book Co. (2nd ed., 1953) $8

Manual of British Water Engineering Practice. Institution of Water Engineers (3rd ed., 1961) $14.70

Manual of Instruction for Water Treatment Plant Operators. New York State Dept. of Health [distributed outside the state by Health Education Service] $1

Manual for Water Works Operators. Texas Water & Sewage Works Assn. (4th ed., 1959) $9

$1,000,000

worth of research available in convenient, usable form at less than the cost of printing, which was largely absorbed by the JOURNAL.

SURVIVAL AND RETIREMENT

Experience With Water Works Facilities

Containing vital information on the actual life of mains, valves, meters, services and other facilities in 26 cities, together with 56 pages of summary tables that condense the data for easier interpretation.

Presents the facts of life (and death) of the facilities of water supplies serving almost 10 per cent of all U. S. consumers plus 400,000 Canadians.

576 pages

List price $3.00

American Water Works Association
2 Park Avenue New York 16, N. Y.

STEEL, ERNEST W. *Water Supply and Sewerage.* McGraw-Hill Book Co. (4th ed., 1960) $11

Water Meters—Selection, Installation, Testing, and Maintenance [AWWA Manual M6]. American Water Works Assn. (1959) $1.25

Engineering Reference

American Civil Engineering Practice. Robert W. Abbett, ed. John Wiley & Sons (1956–57; 3 vols.) $55

ACI Manual of Concrete Inspection. American Concrete Institute (4th ed., 1957) $3.50

ASTM Book of Standards. American Society for Testing and Materials (1958). In 10 parts: 1—Ferrous Metals Specifications, $12; 2—Nonferrous Metals Specifications, Electronic Materials, $10; 3—Methods of Test for Metals (Except Chemical Analysis), $10; 4—Cement, Concrete, Mortars, Road Materials, Waterproofing, Soils, $12; 5—Masonry Products, Ceramics, Thermal Insulation, Acoustical Materials, Sandwich and Building Constructions, Fire Tests, $12; 6—Wood, Paper, Adhesives, Shipping Containers, Cellulose, Leather, $10; 7—Petroleum Products, Lubricants, Tank Measurements, Engine Tests, $12; 8—Paint, Naval Stores, Aromatic Hydrocarbons, Coal, Coke, Gaseous Fuels, Engine Antifreezes, $12; 9—Plastics, Electrical Insulation, Rubber, Carbon Black, $14; 10—Textiles, Soap, Water, Atmospheric Analysis, Wax Polishes, $12

ASTM Index to Standards. American Society for Testing and Materials (issued annually) free

Chemical Engineers' Handbook. John H. Perry, ed. McGraw-Hill Book Co. (3rd ed., 1950) $21

Civil Engineering Handbook. Leonard Church Urquhart, ed. McGraw-Hill Book Co. (4th ed., 1959) $17.50

DAPPLES, EDWARD C. *Basic Geology for Science and Engineering.* John Wiley & Sons (1959) $9.50

Data Book for Civil Engineers. Elwyn E. Seelye, ed. John Wiley & Sons. *Vol. I—Design* (3rd ed., 1960) $24; *Vol. II—Specifications and Costs* (3rd ed., 1957) $20; *Vol. III—Field Practice* (2nd ed., 1954) $8

Handbook of Chemistry. Norbert Adolph Lange & Gordon M. Forker, ed. McGraw-Hill Book Co. (10th ed., 1961) $11

Handbook of Chemistry and Physics. Chemical Rubber Co. (42nd ed., 1961) $12

Handbook of Engineering Fundamentals. Ovid W. Eschbach, ed. John Wiley & Sons (2nd ed., 1952) $11

Hydroelectric Handbook. William P. Creager & Joel D. Justin, ed. John Wiley & Sons (2nd ed., 1950) $17

Kent's Mechanical Engineers' Handbook. John Wiley & Sons (12th ed., 1950). *Power,* $11; *Design and Production,* $10

KRYNINE, DIMITRI P. & JUDD, WILLIAM R. *Principles of Engineering Geology and Geotechnics.* McGraw-Hill Book Co. (1957) $10.50

Metals Handbook. American Society for Metals. *Vol. I—Properties and Selection of Metals* (1961) $30

Modern Physics for the Engineer. Louis N. Ridenour, ed. McGraw-Hill Book Co. (1954) $9

National Fire Codes. National Fire Protection Assn. (1960–61; issued annually). *Vol. I—Flammable Liquids and Gases,* $7; *Vol. II—Combustible Solids, Dusts, Chemicals, and Explosives,* $7; *Vol. III—Building Construction and Equipment,* $7; *Vol. IV—Fixed Extinguishing Equipment,* $7; *Vol. V—Electrical,* $7; *Vol. VI—Transportation,* $7; *Vol. VII—Mobile Fire Equipment,* $7

NFPA Handbook of Fire Protection (Crosby-Fiske-Forster). Robert S. Moulton, ed. National Fire Protection Assn. (11th ed., 1954) $10.50

NFPA Inspection Manual. National Fire Protection Assn. (2nd ed., 1959) $4

Plastics Engineering Handbook. Society of Plastics Industry. Reinhold Publishing Corp. (1960) $15

SAWYER, CLAIR N. *Chemistry for Sanitary Engineers.* McGraw-Hill Book Co. (1960) $9.50

Standard Schedule for Grading Cities and Towns of the United States With Reference to Their Fire Defenses and Physical Conditions. National Board of Fire Underwriters (6th ed., 1956) single copies free to water utilities

Survival and Retirement Experience With Water Works Facilities. American Water Works Assn. (1947) $3

Hydraulics

Basic Hydraulics. Navpapers 16193, US Navy Dept. (1945; 1951) $1.25 [distributed by Government Printing Office]

Engineering Hydraulics. Hunter Rouse, ed. John Wiley & Sons (1950) $15.75

Handbook of Applied Hydraulics. Calvin V. Davis, ed. McGraw-Hill Book Co. (2nd ed., 1952) $17.50

Handbook of Fluid Dynamics. Victor L. Streeter, ed. McGraw-Hill Book Co. (1961) $24

KING, HORACE W. *Handbook of Hydraulics.* McGraw-Hill Book Co. (4th ed., 1954) $10

LELIAVSKY, SERGE. *Irrigation and Hydraulic Design.* Macmillan Co. *Vol. 1—General Principles of Hydraulic Design* (1955) $30; *Irrigation Works* (1957) $60; *Hydraulic Structures for Irrigation and Other Purposes* (1960) $60

MCCLAIN, CLIFFORD. *Fluid Flow in Pipes.* Industrial Press (1952) $3

Pipe Friction Manual. Hydraulic Institute (3rd ed., 1961) $2

Standards of the Hydraulic Institute. Hydraulic Institute (10th ed., revised 1960) $6

VENNARD, JOHN K. *Elementary Fluid Mechanics.* John Wiley & Sons (1961) $7.95

WILLIAMS, GARDNER S. & HAZEN, ALLEN. *Hydraulic Tables.* John Wiley & Sons (3rd ed., rev. 1933) $4.50

WOODWARD, SHERMAN M. & POSEY, CHESLEY J. *The Hydraulics of Steady Flow in Open Channels.* John Wiley & Sons (1941) $4.75

Piping

ASTM Specifications for Steel Piping Materials. American Society for Testing and Materials (1960) $7

American Standard Code for Pressure Piping —ASA B31.1–1955. American Society of Mechanical Engineers (1955) $3.50

BABBITT, HAROLD E. *Plumbing.* McGraw-Hill Book Co. (3rd ed., 1960) $13.50

Concrete Pipe Handbook. Howard F. Peckworth, ed. American Concrete Pipe Assn. (1958) $8

Handbook of Cast Iron Pipe. Cast Iron Pipe Research Assn. (2nd ed., 1952) $5

LINDSEY, FORREST R. *Pipefitters Handbook.* Industrial Press (1953) $6

Piping Handbook. Sabin Crocker, ed. McGraw-Hill Book Co. (4th ed., 1954) $15.50

Corrosion

Cathodic Protection: Report of Correlating Committee on Cathodic Protection. National Assn. of Corrosion Engineers (1951) 50¢

Corrosion Handbook. Herbert H. Uhlig, ed. John Wiley & Sons (1948) $16

SPELLER, FRANK N. *Corrosion: Causes and Prevention.* McGraw-Hill Book Co. (3rd ed., 1951) $14

Steel Structures Painting Manual. Joseph Bigos, ed. Steel Structures Painting Council. *Vol. 1—Good Painting Practice* (1954) $6; *Vol. 2—Systems and Specifications* (1961) $6 (2 vols., $10)

Underground Corrosion. National Bureau of Standards (1957) $3 [distributed as Catalog No. C13.4:579 by Government Printing Office]

Construction and Foundations

BAVER, L. D. *Soil Physics.* John Wiley & Sons (3rd ed., 1956) $7.75

CREAGER, WILLIAM P.; JUSTIN, JOEL D.; & HINDS, JULIAN. *Engineering for Dams.* John Wiley & Sons. *Vol. I—General Design* (1945) $7.25; *Vol. II—Concrete Dams* (1945) $9.25; *Vol. III—Earth, Rock-Fill, Steel, and Timber Dams* (1945) $8.50

HOUGH, B. K. *Basic Soils Engineering.* Ronald Press Co. (1957) $9.50

JACOBY, HENRY S. & DAVIS, ROLAND P. *Foundations of Bridges and Buildings.* McGraw-Hill Book Co. (3rd ed., 1941) $8.50

MCKAIG, THOMAS H. *Field Inspection of Building Construction.* F. W. Dodge Corp. (1958) $9.35

PECK, RALPH B.; HANSON, WALTER E.; & THORNBURN, THOMAS H. *Foundation Engineering.* John Wiley & Sons (1953) $8

Build up your library of AWWA publications the easy, thrifty way with

AWWA PUBLICATION DISCOUNT COUPONS

5¢ value in payment for publications of the AMERICAN WATER WORKS ASSOCIATION
Redeemable for 4¢ cash. Expires Dec. 31, 1965

Members pay only $8.00 for each $10-value coupon book. Coupons may be used until the end of 1965 for the purchase of AWWA standards, reprints, manuals, and books at prices shown in the latest AWWA Publications List (copy on request). Coupons are redeemable for cash without loss at any time till then.

AWWA Publication Sales Dept., 2 Park Ave., New York 16, N.Y.:

Please send me.....$10-value coupon book(s) at $8.00 each.
☐ My check or money order is enclosed. ☐ Bill me as follows:

(Signature of AWWA member or representative) .....

PEURIFOY, R. L. *Estimating Construction Costs.* McGraw-Hill Book Co. (2nd ed., 1958) $11.50

Register of Dams in the United States. T. W. Mermel, ed. McGraw-Hill Book Co. (1958) $12.50

SEELYE, ELWYN E. *Foundations: Design and Practice.* John Wiley & Sons (1956) $16

TAYLOR, DONALD W. *Fundamentals of Soil Mechanics.* John Wiley & Sons (1948) $7.50

TERZAGHI, KARL & PECK, RALPH B. *Soil Mechanics in Engineering Practice.* John Wiley & Sons (1948) $7.50

ADMINISTRATION AND MANAGEMENT

ABBETT, ROBERT W. *Engineering Contracts and Specifications.* John Wiley & Sons (3rd ed., 1954) $6.50

Accident Prevention Manual for Industrial Operations. National Safety Council (4th ed., 1959) $15.50

Accounting for Government-Owned Motor Equipment. Procedural Bulletin, Municipal Finance Officers Assn. (1940) 50¢

BARNES, ROBERT S. *Fire Insurance for Local and State Governments.* Municipal Finance Officers Assn. (1945) $1

CHERMAK, LAWRENCE E. *The Law of Revenue Bonds.* National Institute of Municipal Law Officers (1954) $5

CONOVER, H. S. *Grounds Maintenance Handbook.* F. W. Dodge Corp. (2nd ed., 1958) $10.75

Handbook of Accident Prevention for Business and Industry. National Safety Council (2nd ed., 1958) $2.20

HARRIS, WALTER O. *Municipal Public Works Cost Accounting Manual.* Public Administration Service (1955) $3

MACDONALD, AUSTIN F. *American City Government and Administration.* Thomas Y. Crowell Co. (6th ed., 1956) $6.50

Manual of Water Works Accounting. Municipal Finance Officers Assn. (1938) $4

Municipal Accounting and Auditing. Municipal Finance Officers Assn. (1951) $4

The Municipal Index. American City Magazine Corp. (1961; issued annually) $10

The Municipal Year Book. Orin F. Nolting & David S. Arnold, ed. International City Managers Assn. (1961; revised annually) $10

Operation and Repair of Water Facilities in Civil Defense Emergencies. Technical Manual TM 13-2, Federal Civil Defense Administration (1953) free from state or local civil defense offices

Regulations to Govern the Preservation of Records of Electric, Gas, and Water Utilities. National Assn. of Railroad & Utilities Commissioners (1961) $1

RHYNE, CHARLES S. *The Law of Municipal Contracts, With Annotated Model Forms.* National Institute of Municipal Law Officers (1952) $5

RHYNE, CHARLES S. *Municipal Law.* National Institute of Municipal Law Officers (1957) $22.50

SADLER, WALTER C. *The Specifications and Law on Engineering Works.* John Wiley & Sons (1948) $7

Safety Practice for Water Utilities. Safety Manual [AWWA M3]. American Water Works Assn. (1960) $1.50

Sewage Service Charges in Cities Over 5,000 Population. American Public Works Assn. (1953) $2

Silent Service Is Not Enough! Public Relations Manual [AWWA M2]. American Water Works Assn. (1954) $1.50

Simplified Municipal Accounting. Municipal Finance Officers Assn. (1950) $3.25

A Standard Classification of Municipal Accounts. Municipal Finance Officers Assn. (1953) $3

STEEL, ERNEST W. *Municipal Affairs.* International Textbook Co. (2nd ed., 1950) $5.50

Supervisors Safety Manual. National Safety Council (1956) $4.25

TENNER, IRVING & LYNN, EDWARD S. *Municipal and Governmental Accounting.* Prentice-Hall (4th ed., 1960) $11.35

Uniform System of Accounts for Water Utilities, 1957. National Assn. of Railroad & Utilities Commissioners (1958). *Class A & B,* $4.50; *Class C,* $3.50; *Class D,* $2

Water Rates Manual [AWWA M1]. American Water Works Assn. (1960) $1.25

Water Utility Management Manual [AWWA M5]. American Water Works Assn. (1959) $2

Water Utility Management—Supplementary Readings [AWWA S105]. American Water Works Assn. (1961) $2

Get your copy now!

The QUEST *for*

PURE WATER

by

M. N. BAKER

Here, at long last, is a comprehensive history of water purification from the earliest records to the twentieth century, relived and recorded by M. N. Baker following his retirement as Associate Editor of "Engineering News-Record" in 1932. Here, as Abel Wolman says in his foreward, is "an inexhaustible treasury of authenticated information," which no student of water treatment can afford to miss.

The product of nine full years of research after forty-five years of first-hand observation, Mr. Baker's story of man's 4,000-year "Quest" for a pure supply of drinking water is a must not only for your library but for your reading list.

466 Text Pages
73 Illustrations
900 References

List Price $5.00

Order from

American Water Works Association

2 Park Avenue New York 16, N. Y.

Alphabetical List of Publishers

Academic Press, Inc., 111—5th Ave., New York 3, N.Y.
American City Magazine Corp., 470 Park Ave. South, New York 16, N.Y.
American Concrete Institute, Box 4754, Redford Sta., Detroit 19, Mich.
American Concrete Pipe Assn., 228 N. La Salle St., Chicago 1, Ill.
American Dental Assn., 222 E. Superior St., Chicago 11, Ill.
American Public Health Assn., 1790 Broadway, New York 19, N.Y.
American Public Works Assn., 1313 E. 60th St., Chicago 37, Ill.
American Society of Civil Engineers, 345 E. 47th St., New York 17, N.Y.
American Society of Mechanical Engineers, 345 E. 47th St., New York 17, N.Y.
American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio
American Society for Testing and Materials, 1916 Race St., Philadelphia 3, Pa.
American Water Works Assn., 2 Park Ave., New York 16, N.Y.
Appleton-Century-Crofts, Inc., 35 W. 32nd St., New York 1, N.Y.
Cast Iron Pipe Research Assn., Suite 3440, Prudential Plaza, Chicago 1, Ill.
Chemical Rubber Co., Publications Div., 2310 Superior Ave., Cleveland 14, Ohio
Chlorine Institute, Inc., 342 Madison Ave., New York, N.Y.
Crowell, Thomas Y., Co., 432 Park Ave. South, New York 16, N.Y.
Dodge, F. W., Corp., 119 W. 40th St., New York 18, N.Y.
Donnelley, Reuben H., Corp., 466 Lexington Ave., New York 17, N.Y.
Dover Publications, Inc., 180 Varick St., New York 14, N.Y.
Fleet Publishing Corp., 230 Park Ave., New York 17, N.Y.
Garrard Press, 119 W. Park Ave., Champaign, Ill.
Geological Survey, Washington 25, D.C.
Government Printing Office, Washington 25, D.C.
Harvard Univ. Press, 79 Garden St., Cambridge 38, Mass.
Health Education Service, Box 7283, Albany 1, N.Y.
Hydraulic Institute, 122 E. 42nd St., New York 17, N.Y.
Industrial Press, 93 Worth St., New York 13, N.Y.

Industrial Research Service, Masonic Bldg., Dover, N.H.
Institution of Water Engineers, Parliament Mansions, Abbey Orchard St., London S.W. 1, England
International City Managers Assn., 1313 E. 60th St., Chicago 37, Ill.
International Textbook Co., Scranton 15, Pa.
Johnson, Edward E., Inc., 315 N. Pierce St., St. Paul 4, Minn.
Lippincott, J. B., Co., East Washington Sq., Philadelphia 5, Pa.
Little, Brown & Co., 34 Beacon St., Boston 6, Mass.
Macmillan Co., 60—5th Ave., New York 11, N.Y.
McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y.
Merck & Co., Rahway, N.J.
Missouri Water Well Drillers Assn., Box 250, Rolla, Mo.
Municipal Finance Officers Assn., 1313 E. 60th St., Chicago 37, Ill.
National Assn. of Corrosion Engineers, 1061 M & M Bldg., Houston 2, Tex.
National Assn. of Railroad & Utilities Commissioners, Box 684, Washington 4, D.C.
National Board of Fire Underwriters, 85 John St., New York 38, N.Y.
National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.
National Institute of Municipal Law Officers, 839—17th St., N.W., Washington 6, D.C.
National Lime Assn., 925—15th St., N.W., Washington 5, D.C.
National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.
New York State Dept. of Health, Albany, N.Y.
Office of Saline Water, US Dept. of Interior, Washington 25, D.C.
Prentice-Hall, Inc., Englewood Cliffs, N.J.
Princeton Univ. Press, Princeton, N.J.
Public Administration Service, 1313 E. 60th St., Chicago 37, Ill.
Public Health Service, Attn.: Public Inquiries Branch, Washington 25, D.C.
Reinhold Pub. Corp., 430 Park Ave., New York 22, N.Y.
Ronald Press Co., 15 E. 26th St., New York 10, N.Y.
Steel Structures Painting Council, 4400—5th Ave., Pittsburgh 13, Pa.
Syracuse Univ. Press, Box 87, University Sta., Syracuse 10, N.Y.
Texas Water & Sewage Works Assn., 2202 Indian Trail, Austin 3, Tex.
Univ. of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill.
Water Pollution Control Federation, 4435 Wisconsin Ave., N.W., Washington 16, D.C.
Wiley, John, & Sons, Inc., 440 Park Ave. South, New York 16, N.Y.
Williams & Wilkins Co., 428 E. Preston St., Baltimore 2, Md.

Professional Services

ALBRIGHT & FRIEL, INC.

Consulting Engineers

Water, Sewage, Industrial Wastes and Incineration Problems
City Planning, Highways, Bridges and Airports
Dams, Flood Control, Industrial Buildings
Investigations, Reports, Appraisals and Rates

Three Penn Center Plaza Philadelphia 2, Pa.

BALDWIN & CORNELIUS CO.

Consulting Engineers

Water Supply, Treatment & Distribution
Sanitary Sewers & Sewage Treatment
Industrial Wastes

101 S. Bergen Pl. Freeport, N.Y.

ALDERMAN & SWIFT

Consulting Engineers

Civil—Sanitary—Hydraulic
Reports—Design—Construction Supervision

1520 Oxley St. South Pasadena, Calif.

J. T. BANNER & ASSOCIATES, INC.

Consulting Engineers

Water Works & Sewage Design
Surveys, Reports, Rates & Investigations
Supervision of Construction

Brookings, S. Dak. Laramie, Wyo.

ALVORD, BURDICK & HOWSON

Engineers

Water Works, Water Purification, Flood Relief, Sewage Disposal
Drainage, Appraisals, Power Generation

20 North Wacker Drive Chicago 6

BENJAMIN E. BEAVIN COMPANY

Engineers—Surveyors

Sanitary Engineering Facilities
—Investigations and Reports—
—Design—
—Supervision of Construction—

104 E. Twenty-Fifth Street
BALTIMORE 18, MARYLAND

AUSTIN, SMITH & ASSOCIATES, INC.

Engineers

Investigations, Planning Reports, Designs, Supervision
Water Supply, Purification, Storage and Distribution
Sewerage Systems and Sewage Treatment
Irrigation and Drainage System Works
Airports, Highways and Streets
Structures and Subdivisions

850 Richards Street Honolulu 13, Hawaii

HOWARD K. BELL

Consulting Engineers, Inc.

Water Works Swimming Pools
Industrial Wastes Garbage Disposal
Sewerage Drainage
Valuations—Rates—Reports
Operation Supervision

553 S. Limestone St., Lexington, Ky.

AYRES, LEWIS, NORRIS & MAY

Consulting Engineers

LOUIS E. AYRES ROBERT NORRIS
GEORGE E. LEWIS DONALD C. MAY
STUART B. MAYNARD HOMER J. HAYWARD
JOSEPH D. CRAIGMILE RAYMOND J. SMIT

Waterworks, Sewerage, Electric Power

500 Wolverine Building, Ann Arbor, Michigan

Benham Engineering Company and Affiliates

Dams, Reservoirs, Water Studies, Water Works Systems
Sanitary and Storm Sewers, Sewage Treatment Plants

Surveys.....Design.....Supervision

Oklahoma City, Oklahoma Phoenix, Arizona

Professional Services

BLACK & VEATCH
Consulting Engineers

1500 Meadow Lake Parkway,
Kansas City 14, Missouri

Water Supply Purification and Distribution; Electric Lighting and Power Generation, Transmission and Distribution; Sewerage and Sewage Disposal, Gas, Valuations, Special Investigations and Reports

BOYER-SWEENEY-HAGADORN
Engineers

Streets	Airports	Telephone
Highways	Sewerage	Surveys
Bridges	Water	Subdivisions

107 East Mulberry — Phone TAylor 7-9386
Salina, Kansas

BLACK, CROW & EIDSNESS, INC.
Engineers

Water, sewerage, power, hydrology, recalcination, waste treatment, special investigations and reports, laboratory services

700 S. E. Third Street, Gainesville, Florida
74 Orchid Square, Boca Raton, Florida

BROWN AND CALDWELL
Civil and Chemical Engineers

Water—Sewage—Industrial Waste
Consultation—Design—Operation
Chemical and Bacteriological Laboratories

66 Mint Street — San Francisco 3

H. B. BLECK ENGINEERING

Water Supply & Distribution Systems
Sewers & Sewage Disposal
Valuations—Rate Studies

1321 Glen Rock Ave., Waukegan, Ill.

BUCK, SEIFERT AND JOST
Consulting Engineers

WATER SUPPLY—SEWAGE DISPOSAL—HYDRAULIC DEVELOPMENTS

Reports, Investigations, Valuations, Rates, Design, Construction, Operation, Management, Chemical and Biological Laboratories

112 E. 19th St., New York 3, N. Y.

CLINTON BOGERT ENGINEERS
Consultants

IVAN L. BOGERT, CHARLES A. MANGANARO, ROBERT A. LINCOLN, WILLIAM MARTIN

Water & Sewage Works
Drainage
Highways and Bridges
Incinerators
Flood Control
Airfields

145 East 32nd Street, New York 16, N. Y.

BURGESS & NIPLE
Consulting Engineers
(Established 1908)

Water Supply, treatment and distribution
Sewage and industrial wastes disposal
Investigations, reports, appraisals, rates
Laboratory Municipal engineering
Supervision

2015 W. Fifth Ave. — Columbus 12, Ohio

Bowe, Albertson & Associates
Engineers

Water and Sewage Works
Industrial Wastes
Refuse Disposal
Valuations
Laboratory Service

75 West Street, New York 6, N.Y.
1000 Farmington Ave., West Hartford 7, Conn.

BURNS & McDONNELL
Engineers—Architects—Consultants

4600 E. 63rd St. Trafficway
Kansas City 41, Missouri

Professional Services

JAMES M. CAIRD

Established 1898

C. E. CLIFTON, H. A. BENNETT

Chemist and Bacteriologist

WATER ANALYSIS
TESTS OF FILTER PLANTS

Cannon Bldg. Troy, N. Y.

THE CHESTER ENGINEERS

Water Supply and Purification
Sewage and Industrial Waste Treatment
Power Plants—Incineration—Gas Systems
Valuations—Rates—Management
Laboratory—City Planning

601 Suismon Street
Pittsburgh 12, Penna.

CAMP, DRESSER & McKEE

Consulting Engineers

Water Works, Water Treatment,
Sewerage and Wastes Disposal,
Flood Control

Investigations, Reports, Design
Supervision, Research, Development

18 Tremont St. Boston 8, Mass.

CLARK, DAILY & DIETZ

Consulting Engineers

Sewerage, Waterworks, Street Lighting,
Highways, Swimming Pools, Surveying and
Mapping, Land Development Studies,
Bridges, Buildings, Foundations

211 N. Race St. Urbana, Illinois
188 Jefferson St. Memphis, Tennessee

CAPITOL ENGINEERING CORPORATION

Consulting Civil Engineers

Dillsburg, Pennsylvania, U.S.A.

CHAS. W. COLE & SON

Engineers and Architects

3600 E. Jefferson Blvd. South Bend, Indiana
2112 W. Jefferson St. Joliet, Illinois

JOHN A. CAROLLO

Engineers

Water Supply and Purification, Sewerage,
Sewage Treatment, Industrial Wastes,
Power Generation, Streets

3308 N. Third St. Phoenix 12, Arizona
2168 Shattuck Ave. Berkeley 4, Calif.

CONSOER, TOWNSEND & ASSOCIATES

Consulting Engineers

Sewage treatment, sewers, storm drainage, flood control — Water supply and treatment — Highway and bridges — Airports — Urban renewal — Electric and gas transmisson lines — Rate studies, surveys and valuations — Industrial and institutional buildings.

360 East Grand Avenue Chicago 11, Illinois

CAUFIELD & CAUFIELD

Consulting Engineers

Water Supply, Sewerage, Structures,
Highways, Site Development,
Recreational & Waterfront Facilities

Pearson Building Portland 4, Oregon

C·H₂·M

CORNELL, HOWLAND, HAYES & MERRYFIELD
CONSULTING ENGINEERS

Hydro and Steam Electric Stations
Electric, Water, Sewage and Gas Systems
Structural and Foundation
Designs and Reports
Rates and Special Problems

Seattle Corvallis, Oregon Boise

Professional Services

LEO A. DALY COMPANY

Architects—Engineers—Planners

Water Systems—Waste Disposal
Buildings—Airports—Highways

Municipal—Industrial—Commercial

Omaha
St. Louis Seattle San Francisco

DAY & ZIMMERMANN, INC.

Consulting Engineers

Valuations
Feasibility Studies & Reports
Rate Cases & Financial Studies
Supervisory Consulting Service

1700 Sansom St. Philadelphia 3, Pa.

DeWILD, GRANT, RECKERT & STEVENS

Consulting Engineers

Rock Rapids State Bank Building
Rock Rapids, Iowa

H. G. DILL COMPANY

Consulting Engineers

H. G. Dill G. W. Hockaden
B. W. Lipes J. A. Rousculp
H. J. Roberts P. Priede

Civil, Sanitary, Structural, Municipal, Highway, Subdivision, Planning, Property Surveys, Topographic Surveys, Reports, Appraisals.

2607 1/2 No. High St. Columbus 2, Ohio
267-5446

DILLON

CONSULTING ENGINEERS

Civil • Industrial

M. M. DILLON & COMPANY LIMITED
London - Toronto - Ottawa - Windsor

EASTERN BIOCHEMICAL LABORATORIES

Chemical and Bacteriological Analyses of Water, Sewage and Industrial Wastes

New York State Approved Laboratory

159-07 Fourteenth Avenue,
Whitestone 57, L.I., N.Y.

ENGINEERING-SCIENCE, INC.

Engineers and Consultants

Water Supply and Treatment

Municipal and Industrial Engineering

150 E. Foothill Blvd.
Arcadia, California

Fay, Spofford & Thorndike, Inc.

Engineers

Water Supply and Distribution — Drainage
Sewerage and Sewage Treatment—Incinerators
Airports — Bridges — Express Highways

Investigations Reports Valuations
Designs Supervision of Construction

11 Beacon St., Boston 8, Massachusetts

FINKBEINER, PETTIS & STROUT

Consulting Engineers

Water Supply, Water Treatment,
Sewerage, Sewage Treatment,
Bridges, Highways & Expressways

2130 Madison Avenue Toledo 2, Ohio

FROMHERZ ENGINEERS

Structural—Civil—Municipal

Four Generations Since 1867

Water Supply; Sewerage; Structures; Drainage; Foundations
Highways & Streets
Investigations; Reports; Plans and Specifications; Supervision

New Orleans

Professional Services

GREELEY AND HANSEN
Engineers

Water Supply, Water Purification
Sewerage, Sewage Treatment
Refuse Disposal

14 E. Jackson Blvd., Chicago 4

FULTON & CRAMER
Consulting Engineers

922 Terminal Building — Lincoln 8, Nebraska

John W. Cramer
James D. Kissell — Marvin L. Garber

General Municipal Consultants
Since 1909

WILLIAM F. GUYTON & ASSOCIATES
Consulting Ground-Water Hydrologists

Underground Water Supplies
Investigations, Reports, Advice

307 W. 12th St.
Austin 1, Texas
Phone: GR-7-7165

GANNETT FLEMING CORDDRY & CARPENTER, Inc.
Engineers

Water Works—Sewerage
Industrial Wastes—Garbage Disposal
Roads—Airports—Bridges—Flood Control
Town Planning—Appraisals
Investigations & Reports

Harrisburg, Pa. — Philadelphia, Pa.
Pittsburgh, Pa. — Daytona Beach, Fla.

VICTOR A. HANN, P.E.
Consultant on Ozone

Water Treatment: Removal of Taste Odor and Color; Disinfection

Waste Treatment: Destruction of Phenols, Cyanides, Odor, Color

237 Lancaster Avenue — Devon, Pa.

GEOLOGICAL SERVICE ASSOCIATES
Engineering and Ground Water Geology

Capacity Tests, Investigations, Resistivity and Seismic Surveys, Reports, Well and Well Field Design, Water Chemistry, and Supervision

1014 Havey Road — CHerry 9-1492
Madison 4, Wisconsin

HASKINS, SHARP & ORDELHEIDE
Consulting Engineers

Water—Sewage & Industrial Wastes—Hydraulics
Reports, Design, Supervision of Construction, Appraisals, Valuations, Rate Studies

1009 Baltimore Avenue — Kansas City 5, Mo.

GERAGHTY & MILLER
Consulting Ground-Water Geologists

Location and Evaluation of Industrial and Municipal Ground-Water Supplies
Recommendations for the Solution of Ground-Water Problems

60 East 42nd Street — 44 Sintsink Drive East
New York 17, N.Y. — Port Washington, N.Y.
OXford 7-5448 — POrt Wash. 7-6060

HAVENS & EMERSON
A. A. Burger — A. M. Mock
J. W. Avery — F. S. Palocsay
E. S. Ordway — G. H. Abplanalp
S. H. Sutton
F. C. Tolles, Consultant
Consulting Engineers

Water, Sewage, Garbage, Industrial Wastes, Valuations—Laboratories

Leader Bldg. — Woolworth Bldg.
CLEVELAND 14 — NEW YORK 7

GIBBS & HILL, INC.
Consulting Engineers

Water Supply and Treatment
Industrial and Municipal Waste Treatment
Electric Power and Transmission
Transportation and Communication

Pennsylvania Station — New York 1, New York

HAZEN AND SAWYER
Engineers

Richard Hazen — Alfred W. Sawyer
H. E. Hudson, Jr.

Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control

360 Lexington Ave. — New York 17, N.Y.

Professional Services

ANGUS D. HENDERSON
Consulting Engineers

ANGUS D. HENDERSON THOMAS J. CASEY

Water Supply and Sanitation

330 Winthrop St. Westbury, New York
210-07—29th Ave. Bayside, New York

ROBERT W. HUNT CO.
Inspection Engineers

(Established 1888)

Inspection and Test at Point of Origin of Pumps, Tanks, Conduit, Pipe and Accessories

810 S. Clinton St.
Chicago 7, Ill.
and Principal Mfg. Centers

HENSHAW, HONEYCUTT & LEWIS, INC.
Consulting Sanitary Engineers

JACK A. HENSHAW WILLIS H. LEWIS
SAM W. HONEYCUTT

Water Works—Sewage Works—Industrial Waste Works—Reports—Design Supervision—Operation

206 Stahlman Building, Nashville 3, Tennessee

WILLIAM T. INGRAM
Consulting Engineer

Sanitary and Public Health Engineering
Planning—Design—Research
Water—Sewage—Refuse—Industrial Wastes
Air Pollution Control—Industrial Health

Offices:

East Coast
20 Point Crescent
Whitestone 57, N.Y.

West Coast
90 Panoramic Way
Walnut Creek, Calif.

H. G. Holzmacher & Associates
Consulting Engineers

H. G. HOLZMACHER
R. G. HOLZMACHER S. C. McLENDON

Municipal Engineering
Water Supply & Treatment
Sewerage & Treatment
Water Analysis Laboratory

500 Broad Hollow Road, Melville, New York
66 W. Marie Street, Hicksville, New York

THE JENNINGS-LAWRENCE CO.
Civil & Municipal Engineers
Consultants

Water Supply, Treatment & Distribution
Sewers & Sewage Treatment
Reports—Design—Construction

1392 King Avenue Columbus 12, Ohio

HORNER & SHIFRIN
Consulting Engineers

E. E. Bloss V. C. Lischer

Airports, Sewerage & Drainage, Hydrology, Sewage & Industrial Waste Treatment, Water Supply & Treatment, Paving, Structures, Industry Engineering Services

1221 Locust Street St. Louis 3, Mo.

JONES, HENRY & WILLIAMS
Consulting Sanitary Engineers

Water Works
Sewerage & Treatment
Waste Disposal

2000 West Central Avenue Toledo 6, Ohio

Harold Hoskins & Associates
Consulting Engineers

Aerial Photogrammetry
Sewers and Sewage Treatment
Paving Water Supply Drainage
Bridges Airports Reports
Power Plants Surveys

1630 Q St.
Lincoln 8, Nebr.

1018 8th Avenue
Greeley, Colorado

1403 E. Yellowstone
Casper, Wyoming

2314 River Drive
Great Falls, Mont.

KAISER ENGINEERS
Division of Henry J. Kaiser Company
Engineers—Contractors

Investigations—Reports—Valuations
Design—Construction

Crestview 1-2211
300 Lakeside Drive Oakland, Calif.

Professional Services

RAPHAEL G. KAZMANN

Consulting Ground-Water Engineer

Evaluation of Aquifers
Reports, Plans and Specifications
Supervision of Construction

Stuttgart, Arkansas **Tel. WAbash 2-6424**

DEAN S. KINGMAN

Consulting Engineer

Water Works
Sewerage & Treatment

1907 University Avenue
Palo Alto, California

W. G. KECK & ASSOCIATES, INC.

Consultants in Geophysics

Ground water specialists—serving consulting engineers, municipalities, and industry
Aquifer evaluation—Resistivity surveys
Seismic surveys—Well logging
Geological studies

P.O. BOX 107 **ED 7-1420**
EAST LANSING, MICHIGAN

KIRKHAM, MICHAEL & ASSOCIATES

Engineers - Architects

Complete Municipal & Industrial Services: Investigations, Reports, Design, Supervision of Construction, Rates
WATER—SEWAGE & WASTES—STREETS
AIRPORTS—BRIDGES & STRUCTURES

Omaha, Neb. **508 South 19th St.**
Rapid City, S. D. **519 Kansas City St.**
Fargo, N. D. **802 Sixth Avenue North**

HARRY J. KEELING

Consulting Engineer

Electrical—Mechanical—Corrosion

Investigations—Reports—Advisory Service
Mobile radio communication systems;
Special mechanical design problems;
Soil corrosion, Electrolysis,
Cathodic protection
of buried or submerged metal surfaces.

1780 S. Robertson Blvd. **Los Angeles 35, Calif**

MORRIS KNOWLES INC.

Engineers

Water Supply and Purification,
Sewerage and Sewage Disposal,
Industrial Wastes, Valuations,
Laboratory, City Planning

Park Building **Pittsburgh 22, Pa.**

KENNEDY ENGINEERS

RICHARD R. KENNEDY ROBERT M. KENNEDY

Investigation—Design
Water Supply Water Purification
Sewage and Waste Treatment
Water Reclamation

604 Mission St., San Francisco 5
Tacoma **Los Angeles** **Salt Lake City**

KOEBIG & KOEBIG

Consulting Engineers Since 1910

Investigations, Reports, Designs
Water Supply & Water Treatment
Sewerage & Sewage Treatment
Municipal Engineering

3242 W. Eighth St. **Los Angeles 5, Calif.**

S. LOGAN KERR

Consulting Engineer

Investigations—Reports—Analyses
Water Hammer, Hydraulic Studies, Cavitation
Pipe Lines, Pumping Plants,
Hydro-Electric Plants
Pumped Storage Projects

P. O. Box #6 **Flourtown, Penna.**

LEGGETTE, BRASHEARS & GRAHAM

Consulting Ground Water Geologists

Water Supply **Salt Water Problems**
Dewatering **Investigations**
Recharging **Reports**

551 Fifth Avenue **New York 17, N. Y.**

Professional Services

LOZIER ENGINEERS, INC.

Sewerage, Sewage Disposal,
Water Supply, Water Purification,
Refuse Disposal

10 Gibbs Street, Rochester 4, N.Y.

JAMES M. MONTGOMERY

Consulting Engineers, Inc.

Water Supply—Water Purification
Sewerage—Sewage and Waste Treatment
Flood Control—Drainage
Valuations—Rates
Investigations—Design—Operation

535 E. Walnut St. Pasadena, Calif.

ARTHUR T. LUCE

Consulting Engineer

Water Works—Sewerage
Investigations, Reports, Plans and
Specifications, Appraisals, Rate Studies,
Supervisory Consulting Service

306 Plainfield Road Metuchen, N.J.

WILLIAM J. MURDOCH

Consulting Engineers

Water Supply and Purification, Sewerage
and Sewage Treatment, Industrial Waste
Treatment, Public Health Engineering,
Laboratory

600 Grant Street Pittsburgh 19, Pa.

JAMES F. MacLAREN ASSOCIATES

Consulting Engineers

Municipal engineering
Water supply and purification
Sewerage and sewage disposal
Waste treatment and refuse disposal
Drainage and flood control
Transit structures and bridges

321 Bloor Street East, Toronto 5, Ont.
WA 5-2481

NEWTON, DICKSON & ASSOCIATES LTD.

Supervision Engineers

Preliminary Surveys, Project Management &
Supervision. Sewerage, Water Supply, Roads
& Bridges, Tunnels, Micro-Wave Systems,
Schools & Commercial Buildings

5927 Yonge Street, Toronto, Ont.
Edmonton, Alta. Whitehorse, Yukon Territory

McNAMEE, PORTER AND SEELEY

Consulting Civil Engineers

J. C. Seeley — W. C. Hoad
W. S. Herbert — E. C. Shoecraft
J. M. Holland — R. L. McNamee
M. R. Van Eyck — S. D. Porter

Water Supply, Treatment and Distribution
Sewerage and Sewage Treatment

NOrmandy 3-6177
2223 Packard Road Ann Arbor, Mich.

R. W. NICHOLSON

Consulting Engineer

Water Supply and Treatment
Sewers and Sewage Treatment
Municipal Engineering

921½ Milwaukee Avenue
South Milwaukee, Wisconsin

METCALF & EDDY

Engineers

Investigations · Reports
Planning · Siting · Design
Supervision of Construction & Operation
Valuations · Rates · Research · Management

1300 Statler Building, Boston, Massachusetts

Nussbaumer, Clarke & Velzy, Inc.

Consulting Engineers

Sewage Treatment—Water Supply
Incineration—Drainage
Industrial Waste Treatment
Appraisals

327 Franklin St., Buffalo, N. Y.
500 Fifth Ave., New York 36, N. Y.

Professional Services

THE PITOMETER ASSOCIATES, INC.

Engineers

Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement & Special Hydraulic Investigations

50 Church Street — New York

O'BRIEN & GERE

Consulting Engineers

Water and Sewage Works
Industrial Wastes
Drainage and Flood Control
Airports—Subdivisions
Planning—Electric Power

400 E. Genesee St. — Syracuse 2, N.Y.

POMEROY AND ASSOCIATES

Civil and Chemical Engineers

Water, Sewage, Industrial Wastes
Design, Surveys, Reports, Consultation

Chemical and Bacteriological Laboratory

660 S. Fair Oaks Ave. — Pasadena, California

PARKHILL, SMITH & COOPER

Consulting Engineers

Waterworks, Sewerage, City Planning,
Airfields, Paving, Drainage, Structural

G. W. Parkhill — M. R. Smith, Jr.
S. C. Cooper

Lubbock, Texas — El Paso, Texas

SHEPPARD T. POWELL AND ASSOCIATES

Consulting Engineers

Sheppard T. Powell, *Senior Partner*
H. E. Bacon — E. L. Knoedler
L. G. von Lossberg

Water Conditioning for Industry
Sewage and Industrial Waste Treatment
Corrosion Control, Investigations and Reports

Aurora Federal Building, 305 North Charles Street, Baltimore 1, Maryland

PARSONS, BRINCKERHOFF, QUADE & DOUGLAS

Civil and Sanitary Engineers

Water, Sewage, Drainage and
Industrial Waste Problems.

Structures — Power — Transportation

165 Broadway — New York 6, N.Y.

LEE T. PURCELL

Consulting Engineer

Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Investigations & Reports; Design; Supervision of Construction & Operation

Analytical Laboratories

36 De Grasse St. — Paterson 1, N. J.

BOYD E. PHELPS, INC.

Architects—Engineers

Water Supply, Water Purification
Sewerage, Sewage Treatment
Commercial and Industrial Buildings
Highways and Bridges

1000 Washington, Michigan City, Ind. — 711 K of P Building, Indianapolis, Ind.

RADER AND ASSOCIATES

Engineers and Architects

Water Supply, Treatment and Distribution
Sewers and Sewage Treatment
Investigations, Reports, Plans
Supervision of Construction and Operations
Aerial Photography, Photogrammetry

The First National Bank Building, Miami 32, Florida
1025 Connecticut Ave. N. W. Washington 6, D. C.

MALCOLM PIRNIE ENGINEERS

Malcolm Pirnie — Carl A. Arenander
Ernest W. Whitlock — Malcolm Pirnie, Jr.
Robert D. Mitchell — Alfred C. Leonard

Municipal and Industrial
Water Supply—Water Treatment
Sewage and Waste Treatment
Drainage—Rates—Refuse Disposal

25 W. 43rd St., New York 36, N.Y. — 3013 Horatio St., Tampa 9, Fla.

ROY EDWIN RAMSEIER AND ASSOCIATES

Sanitary and Hydraulic Engineers

Water Supply, Treatment, Distribution
Sewerage and Sewage Treatment
Chemical and Bacteriological Laboratories

1539 Solano Avenue, Berkeley 7, Calif.

Professional Services

THOMAS M. RIDDICK & ASSOCIATES

Consulting Engineers and Chemists

Municipal and Industrial Water Purification, Sewage Treatment, Plant Supervision, Industrial Waste Treatment, Laboratories for Chemical and Bacteriological Analyses

369 E. 149th St. New York 55, N.Y.
MOtt Haven 5-2424

J. HOMER SANFORD

Consulting Engineer—Hydrologist
41 Years of Groundwater Investigation

Groundwater Development, Recharge, Dewatering and Salt Intrusion
Analysis of Available Supply and Safe Yield
Litigation Reports and Testimony

1425 Ocean Ave. Del Mar, Calif.

RIPPLE & HOWE, INC.

Consulting Engineers

V. A. VAREEN B. V. HOWE

Appraisals—Reports
Design—Supervision

Water Works Systems, Filtration and Softening Plants, Reservoirs, and Dams, Sanitary and Storm Sewers, Sewage Treatment Plants, Refuse Disposal, Airports

2747 Zuni St., Denver 11, Colo.

TRUMAN SCHLUP

Consulting Engineer

Highways, Structures, Water, Sewerage
Reports, Design
Investigations, Supervision of Construction

1401 Fairfax Trafficway Kansas City, Kans.

ROBERT AND COMPANY ASSOCIATES

MUNICIPAL ENGINEERING DIVISION
ATLANTA

Power Plants • Water Sewage Plants
Airports • Industrial Plants • Investigations
Docks and Terminal Facilities • Reports

SERVIS, VAN DOREN & HAZARD

Engineers—Architects

INVESTIGATIONS · DESIGN · SUPERVISION OF CONSTRUCTION · APPRAISALS

Water · Sewage · Streets · Expressways · Highways · Bridges · Foundations · Airports · Flood Control · Drainage · Aerial Surveys · Site Planning · Urban Subdivisions · Industrial Facilities
Electrical · Mechanical

2910 Topeka Blvd. Topeka, Kansas

RUSSELL & AXON

Consulting Engineers

Civil—Sanitary—Structural
Industrial—Electrical
Rate Investigations

408 Olive St., St. Louis 2, Mo.
Municipal Airport, Daytona Beach, Fla.

J. E. SIRRINE COMPANY

Engineers
Since 1902
GREENVILLE, SOUTH CAROLINA

Design, Reports, Consultations
Water Supply and Treatment
Sewage and Industrial Waste Treatment
Stream Pollution Surveys
Chemical and Bacteriological Analyses

WILLIAM H. SAMMONS, P.E.

Statistical Hydrologist—Research

Professional Services to Consulting Engineers
Investigations, Reports and Recommendations

8714-63rd Ave., Berwyn Heights, Maryland

A. V. SMITH ENGINEERING CO.

Consulting Engineers

CORROSION CONTROL STUDIES
UNDERGROUND PIPING DESIGN
EVALUATION AND CONSTRUCTION SUPERVISION

ESSEX BLDG. NARBERTH, PA.

Professional Services

ROBERT C. SMITH & ASSOCIATES

Consulting Ground-Water Hydrologists

Investigations — Water Supply
Reports — Dewatering
Well Design — Recharging

16 Leland Ave. — Columbus 14, Ohio

Surveyer, Nenniger & Chênevert

Consulting Engineers

Water Works, Sewerage & Disposal Plants—Drainage & Dams—Roads & Bridges—Town Planning & Appraisals—Investigations, Reports, Plans, Specifications & Supervision
Fifty Years of Experience

Main Office: 1440 St. Catherine Street West, Montreal 25, Que. Canada
Offices also in Baie-Comeau, Que., Sept-Iles, Que., Ottawa, Ont. & New York

SMITH AND GILLESPIE

Consulting Engineers

MUNICIPAL UTILITIES
AND PUBLIC WORKS

Complete Engineering Services

JACKSONVILLE, FLORIDA

GILBERT C. TASSIE

Consulting Engineer

G. C. Tassie, P. Eng. Peter Tassie, P. Eng.

Irrigation, Water Works, Drainage, Highways, Mill Buildings, Appraisals, Town Planning, Surveys, Reports.

Berry Building, Vernon, B.C., Canada.

STANLEY ENGINEERING COMPANY

Consulting Engineers

Hershey Building — **208 S. LaSalle St.**
Muscatine, Ia. — **Chicago 4, Ill.**

Hanna Building
Cleveland 15, Ohio

Toman Engineering Company

Consulting Engineers

Water Supply, Treatment & Distribution, Sewage and Industrial Wastes, Disposal, Investigations, Reports, Appraisals, Rates, Municipal Engineering Supervision, Streets and Airports, Municipal Planning, Sub-Division Layouts.

Member Consulting Engineers Council

Telephone 4483 Box 179 204½ 4th Ave. NW
Mandan, North Dakota

SYDNEY H. STILLEY AND ASSOCIATES

Consulting Engineers

Studies—Planning—Design
Plans—Supervision
Civil—Sanitary—Structural
Mechanical—Electrical
Industrial

1621 Hendricks Avenue Jacksonville, Florida

Associate: The Thomas J. Smith Co.
Dusseldorf—Beirut—Jeddah

W. F. TURNEY AND ASSOCIATES

Consulting Engineers

Water and Sewage Works

Telephone YUcca 3-6957
Santa Fe — **New Mexico**

ALDEN E. STILSON & ASSOCIATES

(Limited)

Consulting Engineers

Water Supply—Sewerage—Waste Disposal
Bridges—Highways—Industrial Buildings
Studies—Surveys—Reports

245 N. High St. — **75 Public Square**
Columbus, Ohio — **Cleveland 13, Ohio**

WARD AND MOORE

Consulting Engineers

Civil, Municipal, Structural, Land Planning

Water Supply, Sewage Disposal, Drainage, Streets, Parks, Subdivisions, Buildings and Structures

Investigations, Reports, Design, Supervision of Construction

P.O. Box 178, Corning, N.Y.

Professional Services

WATER SERVICE LABORATORIES, INC.

Specialists in Water Treatment
Consulting and Technical Services

Main Office: 615 W. 131 St., N. Y. 27, N. Y.
Offices also in: Phila., Wash., & Richmond

J. STEPHEN WATKINS

J. S. Watkins G. R. Watkins
Consulting Engineers

Municipal and Industrial Engineering, Water Supply and Purification, Sewerage and Sewage Treatment, Highways and Structures, Reports, Investigations and Rate Structures.

446 East High Street Lexington, Kentucky
Branch Offices
2617 Dixie Highway, Louisville 16, Kentucky
107 Hale Street, Charleston, W. Va.

R. KENNETH WEEKS

ENGINEERS
Designers • *Consultants*

Water Supply and Purification
Sewerage and Sewage Treatment
Investigations and Reports
Supervision of Construction

Streets and Highways

6165 E. Sewells Point Road, Norfolk 13, Va.

ROY F. WESTON, INC.

Engineers—Biologists—Chemists

Water—Sewage—Industrial Wastes—Refuse
Stream pollution—Air pollution—Industrial Hygiene
Surveys—Research—Development—Process Engineering—Plans and Specifications—Operation Supervision—Analyses—Evaluations and Reports

Newtown Square, Pa.

WESTON & SAMPSON

Consulting Engineers

Water Supply and Purification; Sewerage, Sewage and Industrial Wastes Treatment. Reports, Designs, Supervision of Construction and Operation; Valuations.
Chemical and Bacteriological Analyses

14 Beacon Street Boston 8, Mass.

WHITMAN & HOWARD

Engineers
(Est. 1869)

Investigations, Designs, Estimates, Reports, Supervision, Valuations, etc., in all Water Works and Sewerage Problems

89 Broad St. Boston, Mass.

WHITMAN, REQUARDT & ASSOCIATES

Engineers *Consultants*

Civil—Sanitary—Structural
Mechanical—Electrical
Reports, Plans
Supervision, Appraisals

1304 St. Paul St. Baltimore 2, Md.

WILLIAMS AND WORKS

Civil Engineers
Ground Water Geologists

Water Supplies & Distribution Systems
Sewage & Industrial Waste Works

238 Ottawa Ave., N.W.
Grand Rapids 2, Michigan

WILSEY, HAM & BLAIR

Engineers and Planners

Investigation and Design
Water Supply, Treatment and Distribution
Utilities Rate and Valuation Studies
Sewage Treatment and Disposal
Airports, Municipal Works and City Planning

111 Rollins Road Millbrae, California
800 W. Colorado Blvd. Los Angeles 41, Calif.

YEATTS & DECKER

Consulting Engineers

Abilene, Texas

TANK PAINTING AND REPAIRING SERVICES

W. E. CALDWELL CO.

Builders of elevated water tanks since 1887

Offer maintenance, repair, and inspection service for steel and wood tanks. Nationwide service.

East Brandeis St. Louisville 8, Kentucky

WILLIAM G. PITTMAN CO., INC.

Serving the Northeast Region
Tank Cleaning, Painting & Minor Repairs

61 Voorhis Lane Hackensack, N.J.
Phone: DIamond 3-5185

INDUSTRIAL PAINT COMPANY

NOCORO Coating Systems for Steel Potable-Water Tanks
EPOXY
EPOXY-VINYL
ALL-VINYL
Write or Phone for Brochure and Technical Data Sheets

Haysville Borough Sewickly, Pa.
Phone: PO 6-6300 (Pgh.)

Steel & Tank Service Company Stetsco Service Company

Sandblasting, Coating, and Painting Water Tanks, Filter Plants, and Sewage Plants.

Complete Service for Corrosion Control

Charlotte, N.C. Nashville, Tenn.

THE K. KESSLER CO., INC.

Painting—Repairing

(See our full page ad in this issue)

Fremont, Ohio

WATER TANK SERVICE CO., Inc.

Complete construction and maintenance of standpipes and elevated water storage tanks
Cleaning—Painting—Repairing
37 years experience

10760 Shady Trail
Dallas 20, Texas

NATIONAL TANK MAINTENANCE CORPORATION

"20 Years Bonded"
Water Tank Maintenance

Reconditioning—Sandblasting
Engineering Services—Painting

Home Office
1617 Crocker St.
Des Moines, Iowa
243-8694

Atlanta Division
6075 S. Expressways
Jonesboro, Georgia
478-7102

WATERTOWER PAINT AND REPAIR CO., INC.

"The Tank With The Red Roof"

Clear Lake, Iowa
Box 67 Phone FL 7-2101

NEUMANN COMPANY CONTRACTORS, INC.

Industrial Painting—Sandblasting—Spraying
Power Cleaning—Waterproofing
Tower Lettering

946 W. 69th Street Chicago 21, Illinois
PHONE: HUdson 3-2852—STewart 3-1710

WILLING WATER

Public Relations Consultant

Willing Water is available in blocked electrotypes, newspaper mats, decals, and novelties for use in building public and personnel good will.

Send for catalog and price list

American Water Works Association
2 Park Avenue New York 16, N. Y.

1961 AWWA DIRECTORY

WATER WORKS BUYERS' GUIDE

Classified List of Products • Main & Branch Offices of Manufacturers • Distributors & Representatives

AMERICAN WATER WORKS ASSOCIATION
Incorporated
2 Park Avenue, New York 16, N.Y.

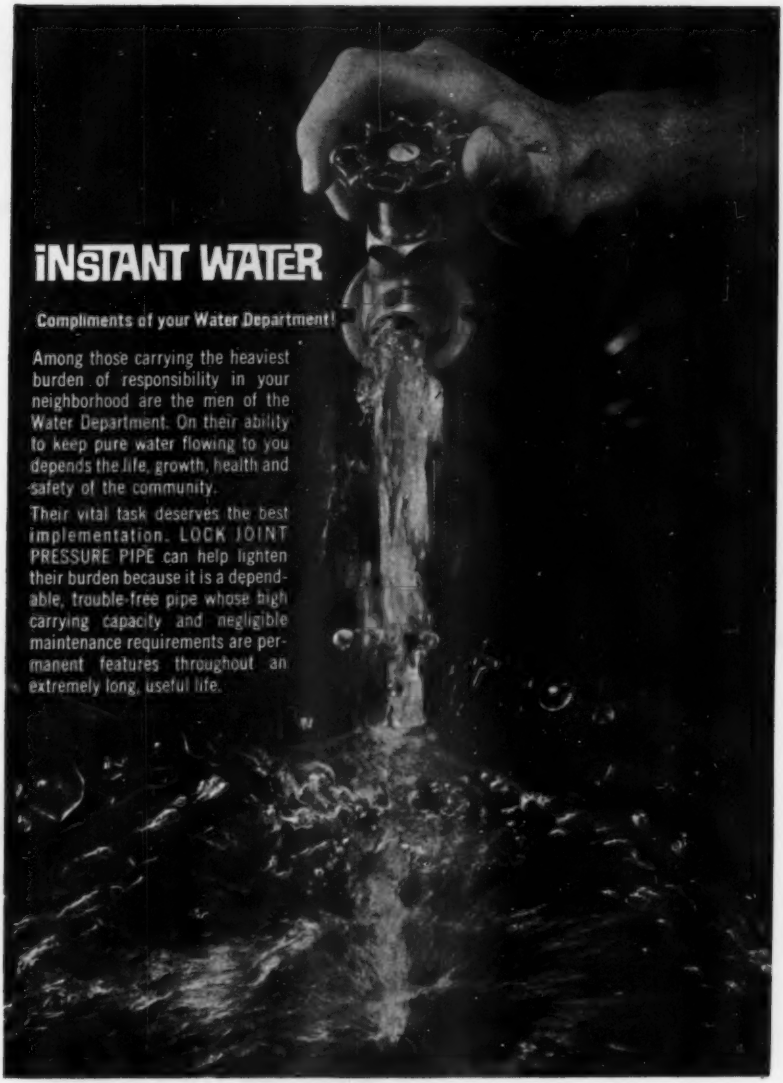
LIQUID-CHLORINE PRODUCERS

In the United States, Canada, and Cuba

Information compiled by the Chlorine Institute

State or Prov.	City	Producer	Containers Filled*
		United States	
Ala.	Huntsville	Chemical Corps (leased to US Industrial Chem. Co.)	T, S
	McIntosh	Olin Mathieson Chem. Corp.	S
	Muscle Shoals	Diamond Alkali Co.	S
Ark.	Pine Bluff	Chemical Corps (leased to Arkansas Louisiana Chem. Corp.)	T, S
Calif.	Pittsburg	Dow Chem. Co.	C, T, S
Ga.	Brunswick	Solvay Process Div., Allied Chem. Corp.	S
Ill.	Monsanto	Monsanto Chem. Co.	S
Kan.	Wichita	Frontier Chem. Co.	C, T, S
Ky.	Calvert City	Pennsalt Chem. Corp.	S
La.	Baton Rouge	Ethyl Corp.	S
	Baton Rouge	Solvay Process Div., Allied Chem. Corp.	C, T, S
	Geismar	Wyandotte Chem. Corp.	S
	Gramercy	Kaiser Aluminum & Chem. Corp.	S
	Lake Charles	Columbia-Southern Chem. Corp.	T, S
	Plaquemine	Dow Chem. Co.	S
Md.	Edgewood	Chemical Corps (leased to Diamond Alkali Co.)	C, T, S
Mich.	Midland	Dow Chem. Co.	S
	Montague	Hooker Chem. Corp.	S
	Wyandotte	Pennsalt Chem. Corp.	C, T, S
	Wyandotte	Wyandotte Chem. Corp.	S
Nev.	Henderson	Stauffer Chem. Co. of Nevada	S
N.H.	Berlin	Brown Co.	C, T, S
N.J.	Linden	Gen. Aniline & Film Corp.	T, S
N.Y.	Niagara Falls	Hooker Chem. Corp.	C, T, S
	Niagara Falls	International Minerals & Chem. Corp.	S
	Niagara Falls	Olin Mathieson Chem. Corp.	T, S
	Niagara Falls	Stauffer Chem. Co.	S
	Syracuse	Solvay Process Div., Allied Chem. Corp.	C, T, S
Ohio	Ashtabula	US Industrial Chem. Co.	S
	Barberton	Columbia-Southern Chem. Corp.	T, S
	Painesville	Diamond Alkali Co.	C, T, S
Ore.	Portland	Pennsalt Chem. Corp.	C, T, S
R.I.	Providence	Fields Point Mfg. Corp.	C, T
Tenn.	Memphis	E. I. du Pont de Nemours & Co.	S
	Memphis	Velsicol Chem. Corp.	S
Tex.	Corpus Christi	Columbia-Southern Chem. Corp.	T, S
	Denver City	Frontier Chem. Co.	C, T
	Freeport-Velasco	Dow Chem. Co.	S
	Houston	Diamond Alkali Co.	C, T, S
	Houston	Ethyl Corp.	S
Va.	Hopewell	Hercules Powder Co.	S
	Hopewell	Nitrogen Div., Allied Chem. Corp.	C, T, S
	Saltville	Olin Mathieson Chem. Corp.	S
Wash.	Longview	Weyerhaeuser Timber Co.	S
	Tacoma	Hooker Chem. Corp.	C, T, S
	Tacoma	Pennsalt Chem. Corp.	C, T, S
W.Va.	Moundsville	Solvay Process Div., Allied Chem. Corp.	S
	New Martinsville	Columbia-Southern Chem. Corp.	T, S
	South Charleston	Chlor-Alkali Div., Food Machinery & Chem. Corp.	T, S
Wis.	Kimberly	Kimberly-Clark Corp.	S
		Canada	
Alta.	Two Hills	Western Chem., Ltd.	C, T, S
B.C.	North Vancouver	Hooker Chem., Ltd.	S
Ont.	Cornwall	Canadian Industries, Ltd.	C, T, S
	Sarnia	Dow Chem. of Canada, Ltd.	C, T, S
Que.	Arvida	Aluminum Co. of Canada, Ltd.	S
	Beauharnois	Standard Chem. Ltd.	S
	Shawinigan Falls	Canadian Industries, Ltd.	S
	Shawinigan Falls	Shawinigan Chem., Ltd.	S
		Cuba	
Las Villas	Sagua la Grande	Electro Quimica del Caribe, S.A.	C, T

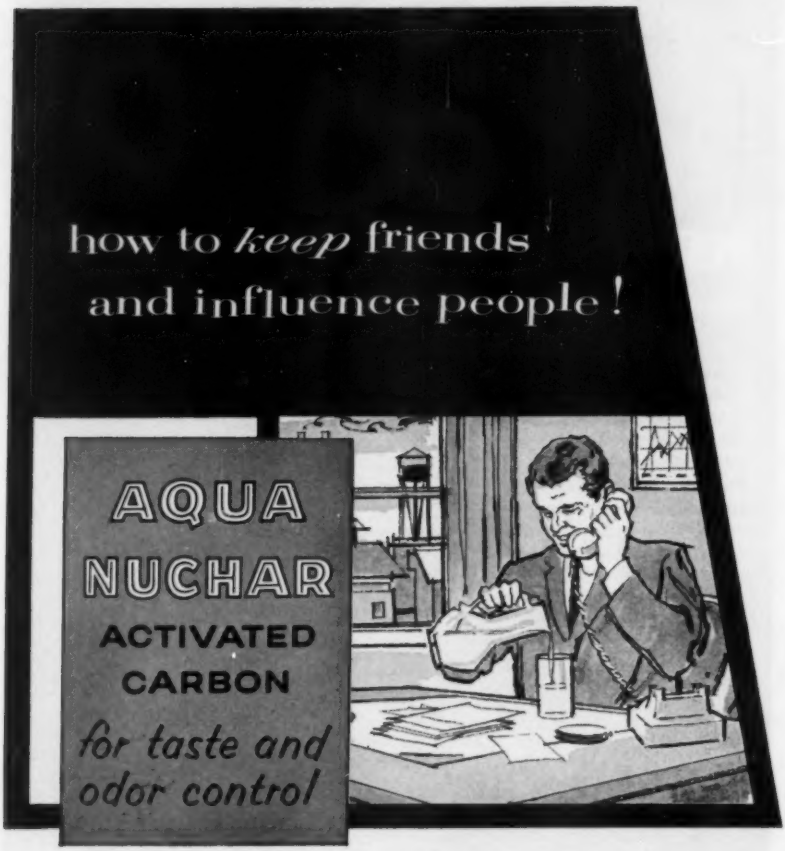
* C—cylinders; T—ton containers; S—single-unit tank cars.


INSTANT WATER
Compliments of your Water Department!
Among those carrying the heaviest burden of responsibility in your neighborhood are the men of the Water Department. On their ability to keep pure water flowing to you depends the life, growth, health and safety of the community.
Their vital task deserves the best implementation. LOCK JOINT PRESSURE PIPE can help lighten their burden because it is a dependable, trouble-free pipe whose high carrying capacity and negligible maintenance requirements are permanent features throughout an extremely long, useful life.

LOCK JOINT PIPE CO.
East Orange, New Jersey

Member of the AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Sales Offices: Chicago, Ill. • Columbia. S.C. • Denver, Col. • Detroit, Mich. • Hartford, Conn.
Kansas City, Kan. • Perryman, Md. • St. Paul, Minn. • Winter Park, Fla.
Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous



You can contribute importantly to building community good will, to attracting new people, new building, new industry, vacationers...all that adds to local prosperity!

You do it by serving water that is *consistently palatable* . . . completely in keeping with the American standard of living today.

You do it by daily threshold odor tests to detect trouble instantly. You know precisely the amount of AQUA NUCHAR needed from day to day to adsorb all taste-and-odor-forming substances. And you thereby save your town money.

When unusual problems arise, you can rely on our authoritative technical service. We're glad to be part of your plan to *keep* friends and influence people.

West Virginia Pulp and Paper
INDUSTRIAL CHEMICAL SALES DIVISION

230 Park Ave., New York 17 · Philadelphia National Bank Bldg., Philadelphia 7
35 E. Wacker Dr., Chicago 1 · 2775 S. Moreland Blvd., Cleveland 20

longer life
PATENTED SILICONE
STUFFING BOX PACKING
constantly improved
parts always available
WATCH DOG
Split case or frost proof
Offices in principal cities
GAMON METER DIVISION
NEWARK
NEW JERSEY
WORTHINGTON

PIPE THAT SHOULDERS A HEAVY LOAD WITHOUT SHOWING ITS AGE

Recently installed in a town in Illinois, this cast iron pipe water supply system now serves a large industrial area.

Besides the internal pressure of supplying the heavy daily demand, there is a heavy load overhead, too. The industrial area is a packaging and distribution center. Large numbers of fully loaded rail cars and trucks come and go every day.

As far as the cast iron pipe is concerned, this is all in a day's work.

Cast iron pipe shoulders heavy loads—interior and exterior—year after year; performs efficiently for a century or more.

And it always delivers a full flow of water.

ADVERTISING CAMPAIGN FROM CAST IRON PIPE RESEARCH ASSOCIATION SHOULDERS A HEAVY LOAD, TOO!

For years the Cast Iron Pipe Research Association has attacked the water problem nationally; now, in addition, it is undertaking a new campaign to combat this crisis on a local level. Car cards, speeches, radio spots, newspaper ads, mailing pieces—everything will be included. If your town's problem is apathy or a growing water shortage, we may be able to help. For complete details, write to the Cast Iron Pipe Research Association today!

CAST IRON PIPE RESEARCH ASSOCIATION
Thos. F. Wolfe, Managing Director
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE

Pure filtered water...
YOUR
RESPONSIBILITY

Quality controlled alum...
OUR
RESPONSIBILITY

You can order Cyanamid Alum for your filtration processes with the utmost confidence because Cyanamid Alum is quality controlled from start to finish to meet stringent specifications. Manufacturing plants are strategically located to give efficient service throughout the country.

Supplied in the form you want

LIQUID — for cleaner, easier, more economical operation. In tank wagons and tank cars from 9 convenient shipping points. Conforms fully to AWWA standards.

DRY — conforms fully to AWWA standards in ground, rice, lump or powdered grades. Bagged or bulk.

THINKING OF CONVERTING TO LIQUID? Your costs—and savings—can be determined quickly by a Cyanamid representative with years of conversion experience at your service. Just call Cyanamid for product or technical service.

ALUM CYANAMID

AMERICAN CYANAMID COMPANY

Process Chemicals Department, 30 Rockefeller Plaza, New York 20, N. Y.
In Canada: Cyanamid of Canada Limited, Montreal and Toronto

FOR LIFE-OF-BOND PERFORMANCE

Make your new or expanded water works system "pay off", not "pay out"! Don't risk plant obsolescence or equipment failure during the 20, 30 or 40 year life of the bond issue!

If you want reliable life-of-bond performance, specify B-I-F equipment . . . the most comprehensive, proven line of water works equipment. No other company can back its product line with so many successful municipal water works installations.

The entire B-I-F product line was developed for easy system integration. These compatible components *in your system* mean faster coordination, minimum start-up time, maximum reliability, minimum initial and long term costs, and the dependable, single responsibility only B-I-F can offer.

METERS AND CONTROLS Complete line of Primary Metering Elements: Venturi Tubes and Nozzles; Dall Flow Tubes; Telemeters for Flow, Pressure, Temperature, Level, Position and Electrical Quantities; Velocity-type Meters.

FEEDERS AND WEIGHERS Wide Range of Volumetric and Belt Gravimetric Feeders for Dry Materials and Liquids; Belt Weighers; Chlorine Gas Feeders (Floor Models and Compact, Wall-Mounted Units).

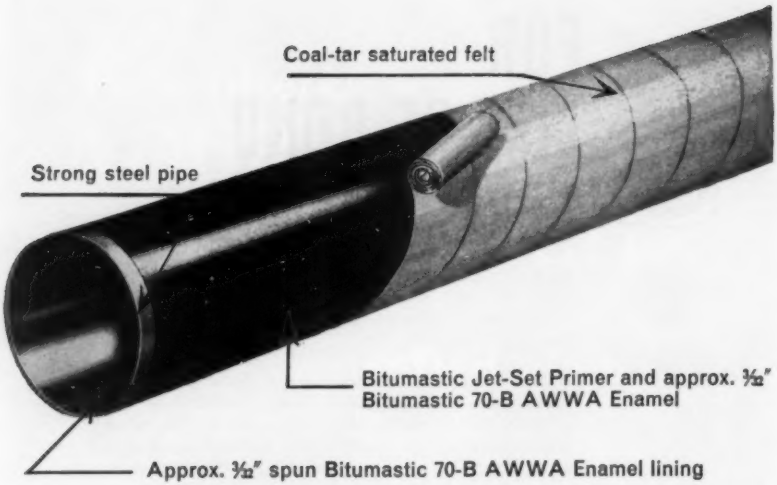
VALVES Butterfly Valves and Operators for Low and High Pressure Applications.

SYSTEMS Supervisory Control Systems; Filters & Filter Control Systems; Volumetric and Gravimetric Systems for Automatic Blending, Feeding, Treating, Sampling.

B-I-F *Industries*
A DIVISION OF THE NEW YORK AIR BRAKE COMPANY

METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

Request complete data on any product or system, Write
B-I-F Industries, 365 Harris Avenue, Providence 1, Rhode Island.


Coal-tar saturated felt
Strong steel pipe
Bitumastic Jet-Set Primer and approx. 1/32"
Bitumastic 70-B AWWA Enamel
Approx. 1/32" spun Bitumastic 70-B AWWA Enamel lining

BEST FORMULA FOR WATER LINE LIFE

Strong Steel Pipe + Coal-Tar Enamel

The superior flow characteristics of steel water pipe lined with Bitumastic® 70-B AWWA coal-tar enamel are well-known. Smoothest of all spun pipe linings, coal-tar enamel also gives long-term protection against tuberculation and incrustation, causes of reduced flow capacity.

And when the *outside* of your water line is completely protected by Bitumastic Jet-Set Primer and Bitumastic 70-B AWWA Enamel, moisture can't reach the metal, so corrosion can't start. For coal-tar enamel has superior resistance to water penetration and absorption, and higher electrical resistivity underground: has been proved by actual experience to provide better protection than any other coating. Utilization of the outstanding strength of steel pipe guarded by coal-tar enamel adds up to true water line durability.

When you invest in a water line, it makes good economic sense to specify the finest: steel pipe, lined and coated with Bitumastic coal-tar enamel. Koppers Company, Inc., Tar Products Division, Pittsburgh 19, Pennsylvania.

KOPPERS
BITUMASTIC
ENAMELS

another fine product of COAL TAR

District Offices: Chicago, Los Angeles, New York, Pittsburgh, Woodward, Ala.

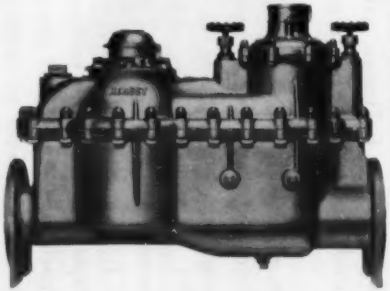
HERSEY DISC WATER METER MODEL HF and F

(for freezing zones)

Sizes $\frac{5}{8}$″, $\frac{5}{8}$″ x $\frac{3}{4}$″, $\frac{3}{4}$″ and 1″

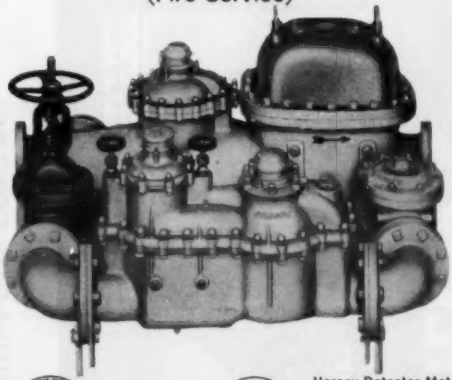
HERSEY COMPOUND WATER METER MODEL CT

Single Bronze case: 2″, 3″, 4″, 6″ sizes
Galvanized Iron cases: 8″, 10″ sizes



HERSEY DETECTOR METERS MODEL FM-CT

(Fire Service)

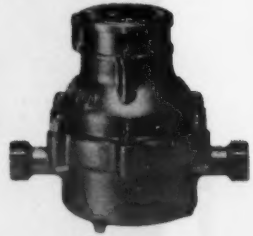


Hersey Detector Meters Model FM (Fire Service), with Disc by-pass, in sizes 3″ through 10″ and Model FM-CT, with compound by-pass, in sizes 6″, 8″ and 10″ are listed as standard under the re-examination service of Underwriter's Laboratories, Inc. and approved by Factory Mutual Laboratories for use in Factory Mutual insured properties, also listed by Underwriter's Laboratories of Canada.

HERSEY DISC WATER METER MODEL HD

(for non-freezing zones)

Sizes $\frac{5}{8}$″, $\frac{5}{8}$″ x $\frac{3}{4}$″, $\frac{3}{4}$″, 1″, 1$\frac{1}{4}$″, 1$\frac{1}{2}$″, 2″, 3″



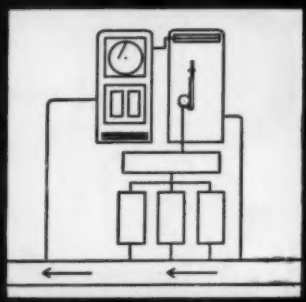
THE WORLD'S MOST COMPLETE LINE OF WATER METERS

HERSEY

Hersey-Sparling
Meter Company
HERSEY PRODUCTS
DEDHAM, MASSACHUSETTS

Branches: Atlanta, Boston, Chicago, Cleveland, Dallas, Denver, Kansas City, Mo., Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle.

Let automation stretch the **FLEXIBILITY** of your chlorination system...



W&T **COMPOUND-LOOP CONTROL**

Compound-loop Control by Wallace & Tiernan maintains chlorine residuals automatically—provides utmost flexibility in arrangement and process control.

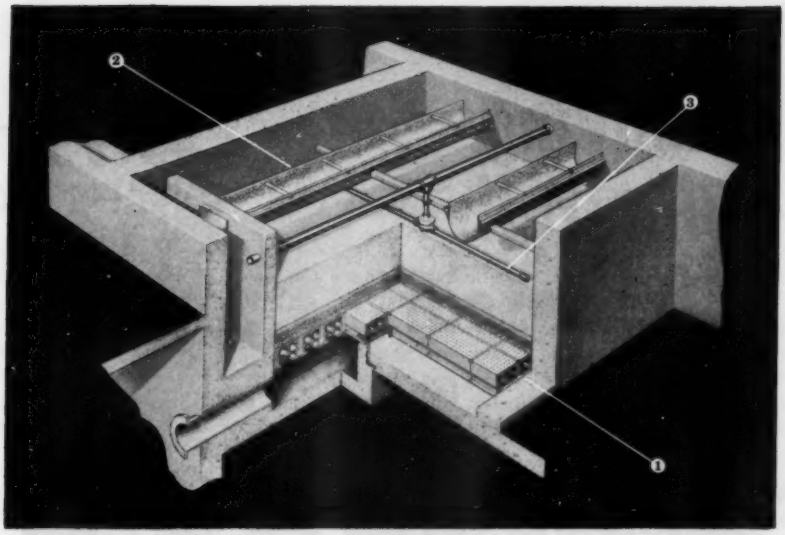
Chlorinator feed rate is adjusted by two signals: one from water flow, the other from continuous, automatic residual analysis. Since feed rate is the product of these signals, Compound-loop Control gives you a range of greater than 100:1. No matter how much flow or demand changes, your system always maintains the selected residual.

Regardless of the size, type, or physical layout of your system, Compound-loop Control adapts readily. Electric, pneumatic, or variable vacuum control signals can be used. And you can install Compound-loop Control as a package or convert to it, component by component, as your system expands.

For more information, write Dept. S-145.05

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

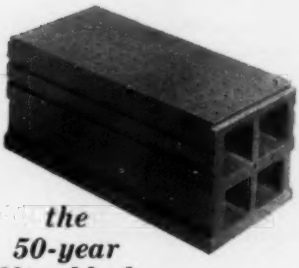


FROM TOP TO BOTTOMS . . . SPECIFY LEOPOLD

1 **Leopold Glazed Tile Filter Bottoms.**

2 **Leopold Fiberglass-Reinforced Plastic Wash Troughs.**

3 **Leopold Rotary Surface Washers.**



the 50-year filter block

Now you can specify an entire non-corroding filter installation from Leopold . . . your experienced source of supply. For lowest "over-the-years" cost, choose performance-proved Leopold glazed tile filter bottoms, built to last at least half a century. Tough Leopold fiberglass-reinforced wash troughs require no painting or other expensive maintenance. And new Leopold self-propelled rotary surface washers complete the package with a dependable product that's guaranteed for five years against mechanical and functional defects. Leopold filter plant equipment is used in thousands of plants throughout the country, on both new and rehabilitation projects. Choose these time-tested products by Leopold . . . for your complete filter needs. Write today for facts and figures.

Leopold

F. B. LEOPOLD CO., INC., Zelienople, Pa.

F. B. LEOPOLD CO., INC., Zelienople, Pa.

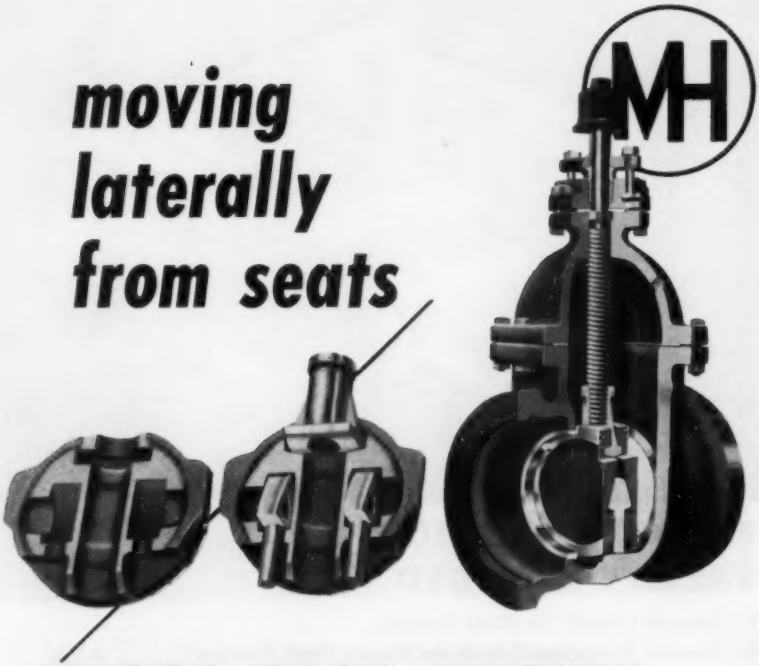
☐ Please send literature on Leopold Glazed Tile Filter Bottoms.
☐ Please send literature on complete line of Leopold products.

Name _____

Affiliation _____

City _____ Zone ____ State _____

moving laterally from seats



DISCS RISE EASILY

Easy and efficient operation of an M & H Valve is due to the fact that the three gate spreaders simultaneously release the lateral pressure of the discs against the seats when the valve is opened. This permits the discs to move laterally away from their seats and rise easily. The action is reversed when the valve is closed.

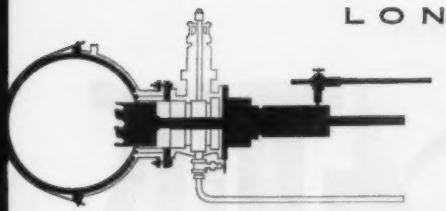
There is no sliding action of the discs against the seats, hence no wear. The discs are bronze-faced and the two direct-acting spreaders are solid bronze. Simple design and rugged construction are features of this double-disc gate assembly of M & H Valves.

With certain changes, this same mechanism is incorporated in M & H Square Bottom Valves which are especially designed for throttling purposes. *Write or phone . . .*

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF W WALWORTH

LONG-TERM ECONOMY



TAPPING UNDER PRESSURE

Pressure tapping Concrete Pressure Pipe is easy and economical. A small crew working with standard equipment can install a new outlet in a concrete pipeline in a few hours, without interrupting service to your customers. ■ Saddle type outlets are readily available for installation by your own forces or by others. Properly installed with protective concrete coatings, these outlets will be as durable and dependable as the pipeline itself. ■ To keep pace with the constant increase in demand for water, most municipalities and water agencies in the West have successfully expanded existing water supply systems by pressure tapping their concrete pipelines. ■ In addition to other assistance an American sales engineer will be glad to show you a motion picture film demonstrating the tapping procedure. The simplicity of pressure tapping is another reason why Concrete Pressure Pipe means long term economy for you.

American Pipe and Construction Co. • Los Angeles • San Diego • Hayward • Portland
Bogota, Colombia / **American Concrete Pipe Co.** (subsidiary) • Phoenix • Albuquerque

MEMBER OF THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

American PIPE AND CONSTRUCTION CO.

THIS ECCENTRIC VALVE DOES NOT NEED LUBRICATION, YET IT CLOSES DEAD TIGHT, OPENS EASILY, AND PROVIDES THESE EXCLUSIVE ADVANTAGES

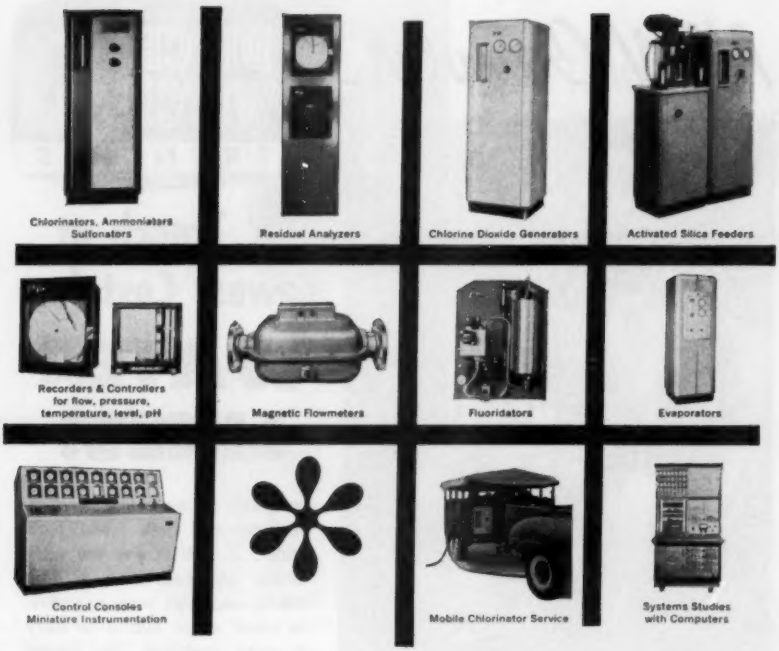
Its **CORROSION RESISTANT BEARING BUSHINGS** will not "freeze" or stick, preventing operation of the valve, even after long periods of inoperation. The **SMALL DIAMETER STEM BEARING** means less friction; less torque is required to operate the valve, yet the stem is more than strong enough for the most rugged services. The **LEAK-PROOF STEM SEAL** is self-adjusting, under constant spring pressure, with multiple surfaces in contact with the rotary stem for longer life without leakage. When it is necessary, worn stem packing may be replaced in the **REPACKABLE STEM** without removing the plug.

AND ONLY DeZURIK MAKES IT!

DeZurik Valves, with Eccentric Action, are the perfect valve for so many water works services; on sand filter intake, discharge and backwash, structure drainage discharge, rewash, wash water to filter, wash water to drain . . . in short, on almost *any* water works line. Their rugged construction . . . their nickel seats . . . their freedom from special care of any kind makes them the top performer in so many ways.

Get more information from the DeZurik representative in your area, or write to

DeZURIK CORPORATION
SARTELL, MINNESOTA



*For Automation of Water Treatment...

Complete Instrumentation and Chlorination Equipment

Why shop around for system components? Save time and money as you design automation for your water plant—and gain years of trouble-free service after installation—with F&P instrumentation and chlorination systems. Flowmeters, recorders, controllers and chemical treatment equipment can all be selected as a coordinated system—from a single, reliable source! And the unusually wide F&P selection means we can recommend without prejudice.

For basic information or specific suggestions, write Fischer & Porter Company, 985 Warminster Road, Warminster, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane Street, Toronto.

FP

FISCHER & PORTER COMPANY

CHLORINATION AND INSTRUMENTATION

NEW Crawler

DITCH WITCH TRENCHER

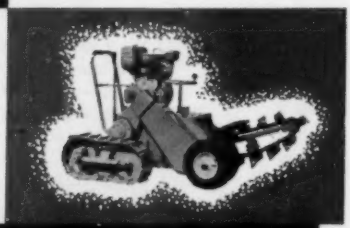
Trench at Lowest Cost for WATER LINES!

Slash costs on water line trenching with the new track model Ditch Witch . . . built to give you extra traction and flotation, with easy steering and high maneuverability. Its added weight suits it to frosty or rocky conditions. The crawler Ditch Witch does a straight-line job of trenching, digging from 4" to 12" wide . . . up to 5' cover!

12 HP Crawler Model M-322 CR shown here. Choice of track or rubber-tire in both 9 and 12 HP!

DITCH WITCH

rubber-tire models in other sizes from 7 to 30 HP dig up to 16" wide and up to 6' deep. The 30 HP Hydraulic Drive K-1 is pictured below.



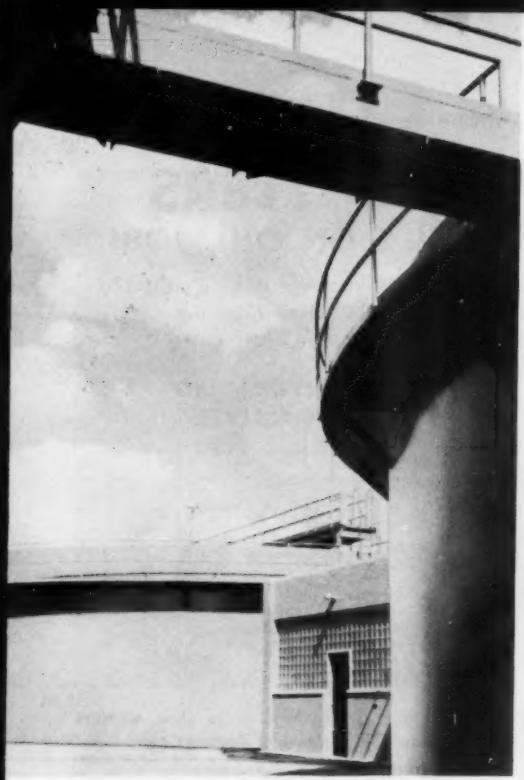
Mfd. by

CHARLES

Machine Wks., Inc.

649 Birch St. • Perry, Okla.

Call Collect: FE 6-4404

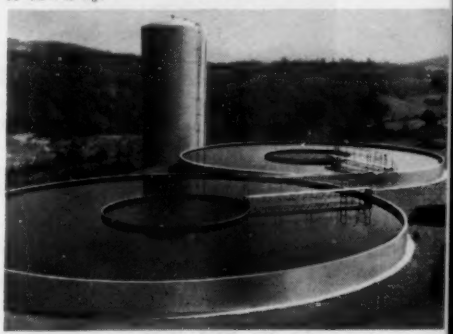


Two of four purification units at Lexington, Kentucky—each 69' 8" dia x 17' 9" high —for American Water Works Service Co.

CRAFTSMANSHIP AND PERFORMANCE IN STEEL WATER PURIFICATION AND FILTRATION FACILITIES BY PITTSBURGH-DES MOINES

Lexington, Kentucky installation with 200,000 gallon standpipe. 28' dia x 45' high

The projects pictured typify the long experience of PDM in serving dependably the waterworks field. The same care and skill in construction that have made PDM elevated steel tanks, standpipes and reservoirs the standard of value and performance wherever water is stored, apply equally to the long-lived steel structures PDM builds for modern water filtration and purification. • When water handling is your problem, you'll find the best solution begins with a call to Pittsburgh-Des Moines!



Two of four water treating units at Greensburg, Pennsylvania—each 84' dia x 18' high—and 300,000 gallon standpipe, 28' dia x 65' high, for Municipal Authority of Westmoreland County, Pennsylvania.

PDM
ELEVATED STEEL TANKS

Pittsburgh-Des Moines Steel Company

Plants at PITTSBURGH, WARREN, BRISTOL, PA. • BALTIMORE • BIRMINGHAM • DES MOINES PROVO, UTAH • CASPER, WYO. • SANTA CLARA, FRESNO, STOCKTON, CALIF.

Sales Offices

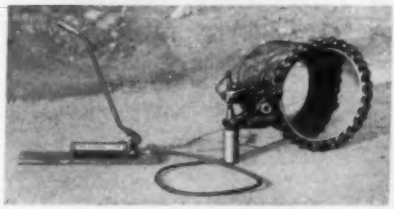
PITTSBURGH (25)	Neville Island
WARREN, PA.	P. O. Box 660
BALTIMORE (26)	P. O. Box 3459, Curtis Bay Station
BIRMINGHAM (8)	P. O. Box 8641, Ensley Station
DES MOINES (8)	1015 Tuttle Street
PROVO, UTAH	P. O. Box 310
SANTA CLARA, CALIF.	P. O. Box 329
EL MONTE, CALIF.	P. O. Box 2012
NEW YORK (17)	200 East 42nd Street
NEWARK (2)	744 Broad Street
CHICAGO (3)	679 First National Bank Bldg.
ATLANTA (5)	361 East Paces Ferry Rd., N.E.
DALLAS (1)	Suite 1703, Southland Center
DENVER (2)	323 Railway Exchange Bldg.
SEATTLE (1)	500 Wall Street

WHEELER PIPECUTTERS

CAN PAY FOR THEMSELVES ON ONE JOB!

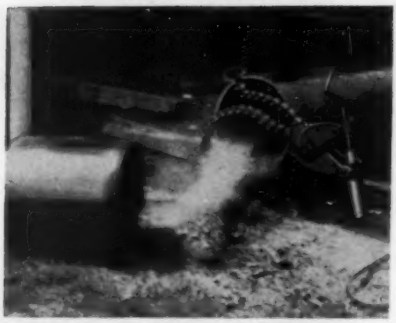
The Wheeler line of pipe cutters can handle a wide range of pipe sizes and materials quickly and easily. All you do is wrap the chain around the pipe, engage it in the cutter's upper jaws, adjust slack and operate cutter.

"SUPER"
HYDRAULIC PIPE CUTTER
MODEL 5590



for 10" thru 20"
CAST IRON WATER MAIN AND TILE THRU 42" DIA.

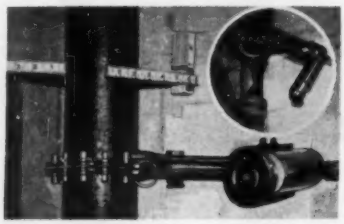
HEAVY-DUTY
HYDRAULIC PIPE CUTTER
MODEL 3890



Shown here in the act of cutting a section of large diameter cast iron water main. Recommended for—

- 4" thru 12" ASA class 22 C.I. water main
- 4" thru 10" ASA class 26 C.I. water main
- Terra Cotta or tile pipe thru 36"
- Asbestos Cement Pressure pipe
- Std or XH Soil Pipe—all sizes

JR. HYDRAULIC PIPE CUTTER MODEL 1790



Ideal for use overhead or in close quarters (as shown). For smaller diameter pipe

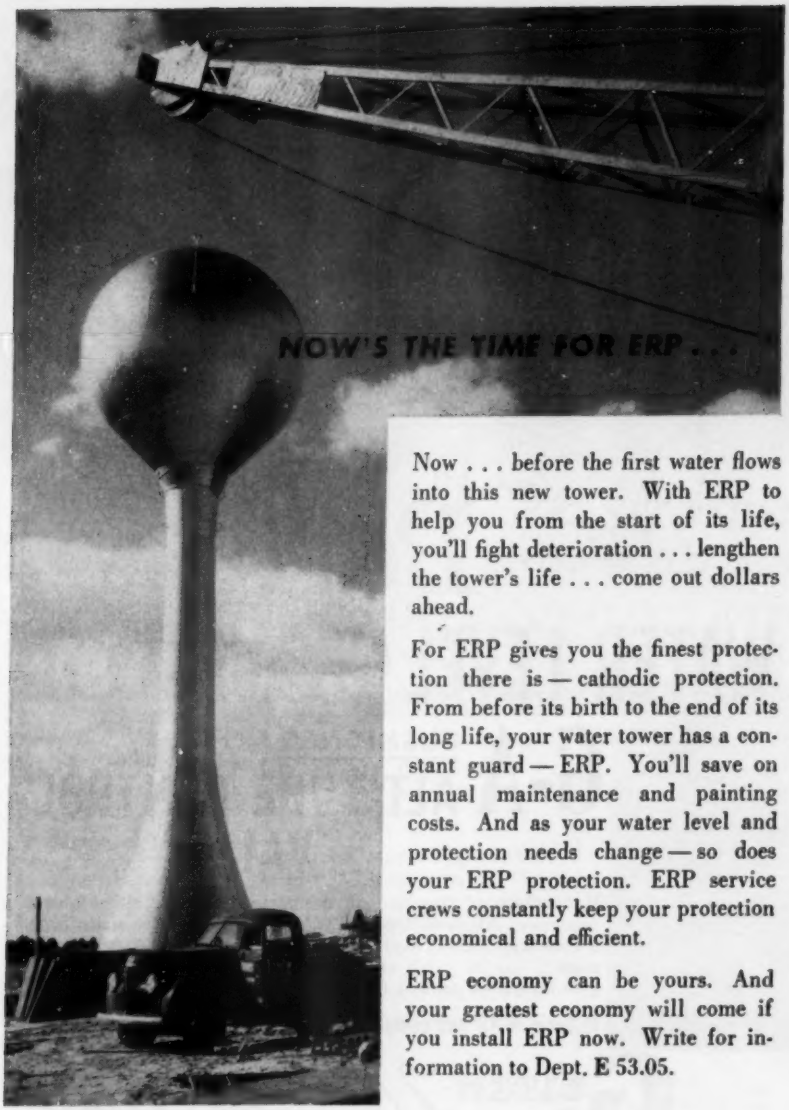
- 2" thru 3" C. I. water main
- Asbestos Cement Pipe—rd. or oval
- Corrosion Resistant Pipe
- Terra Cotta or Tile—4" thru 15"
- Std. or XH Soil Pipe—2" thru 8"

MANUAL PIPE CUTTER MODEL 590K

The original Wheeler "Squeeze and Pop" pipe cutter. Recommended for smaller diameter soil pipe, tile corrosion resistant pipe and Asbestos Cement pipe. Note: Maximum pipe size requirements for *any* Wheeler Cutter will determine total price and must be specified when ordering.

WHEELER MANUFACTURING CORP.

P. O. Box 688 **Ashtabula, Ohio**



Now . . . before the first water flows into this new tower. With ERP to help you from the start of its life, you'll fight deterioration . . . lengthen the tower's life . . . come out dollars ahead.

For ERP gives you the finest protection there is — cathodic protection. From before its birth to the end of its long life, your water tower has a constant guard — ERP. You'll save on annual maintenance and painting costs. And as your water level and protection needs change — so does your ERP protection. ERP service crews constantly keep your protection economical and efficient.

ERP economy can be yours. And your greatest economy will come if you install ERP now. Write for information to Dept. E 53.05.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.

A SUBSIDIARY OF WALLACE & TIERNAN INC.

30 MAIN STREET, BELLEVILLE 9, NEW JERSEY

CABLE: ELECTRO, NEWARK, N. J.

Perfect WATER LEVEL Control

G-A CUSHIONED ALTITUDE CONTROL VALVE

Regardless of the size of the elevated tank, the Golden Anderson Altitude Control Valve automatically maintains a constant water level and prevents overflow. Available in sizes 2" to 36", this valve is normally housed in an underground pit to protect from inclement weather.

Bulletin W-4B has complete technical data.

GOLDEN ANDERSON Valve Specialty Company

1221 RIDGE AVENUE, PITTSBURGH 33, PA.

Designers and Manufacturers of VALVES FOR AUTOMATION

FOR HUNDREDS OF YEARS, THE BEST CONVEYER OF WATER KNOWN TO MAN

CAST IRON PRESSURE PIPE

In large cities or small towns, housing developments, military installations, on golf courses – our thirsty and constantly expanding nation needs an ever increasing amount of water – Cast Iron Pressure Pipe is the safest, most economical carrier. This has been proven for hundreds of years.

Lone Star Bell-Tite Joint Cast Iron Pressure Pipe is the modern and economical way to install water mains. The entire operation is quick and simple . . . insert rubber gasket into receiver groove of bell, apply special lubricant to gasket, slide spigot into bell. That's all there is to it.

Lone Star's scientifically designed bell will provide an automatic and pressure tight seal that is actually stronger than the pipe barrel itself.

Richmond, Va., 10" Cast Iron water main installed in 1830 and still in service.

Lone Star STEEL COMPANY

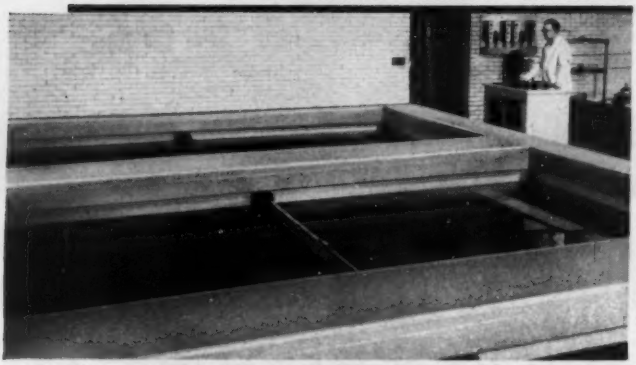
EXECUTIVE – SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas

DISTRICT SALES OFFICES
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

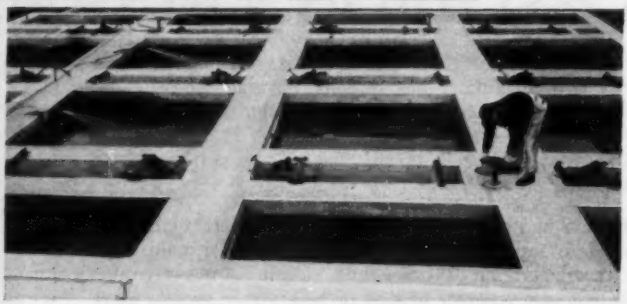
SOUTH HAVEN, MICHIGAN

SEWAGE WORKS — **25 YEARS LATER, 95% PERFECT... SUBMERGED INERTOL® STANDARD PAINT**

WATER WORKS — **6-8 YEARS WITHOUT REPAINTING ...SUBMERGED TOREX® ENAMEL**



WATER WORKS Interior view of the South Haven Water Works with Mr. Clair B. Mills, operator at the control panel where he is washing filter. Filters are protected and beautified with Torex Enamel.



SEWAGE WORKS Exterior of the South Haven Pollution Control Plant where the submerged areas of the Imhoff tanks are painted with Inertol Standard. Adjusting tank valves is Mr. Everett Hattabaugh, supervisor and chemist.

The city of South Haven is pleased with Inertol Standard in its sewage plant. Over 25 years ago two coats were applied to Imhoff tank interiors. "Today," says Mr. Max L. Norris, superintendent, "the overall paint job is still in 95% good condition; it is practically perfect on submerged surfaces not subject to tank level fluctuation."

In the South Haven water works, colorful Torex Enamel protects filter walls. "Despite the continued submersion," reports Mr. Norris, "the filters are only repainted with Torex every 6-8 years. Just one coat is required for repainting."

For further data on Torex Enamel, write for Bulletin WS579; on Inertol Standard (for sewage plants only), Bulletin SW594.

A complete line of quality coatings for water, sewage and industrial wastes plants, and swimming pools.

INERTOL CO., INC.

484 Frelinghuysen Avenue, Newark 12, N. J.
27-G South Park, San Francisco 7, Cal.

BONDED
WATER TANK MAINTENANCE

★ ★ ★ ★

Performance guaranteed by a nationally known Surety Company

We pioneered annual maintenance which
—Costs less to the customer
—Assures trained workmen
—Assures quality results
—Provides emergency services

Cleaning, rust prevention and painting of elevated tanks *is a specialty*. Our program supplements cathodic control systems (if in use).

Because of inspection difficulties, buyers must rely on the integrity of the company with whom they do business. *Only* National Tank Maintenance Corporation backs up its maintenance contracts by a surety performance bond.

OFFERED ONLY BY

NATIONAL TANK MAINTENANCE CORPORATION

"Home Office"
1617 Crocker St.
Des Moines, Iowa
243-8694

"Atlanta Division"
6075 S. Expressway
Jonesboro, Georgia
478-7102

Write, Telephone, or Wire Collect

"Every Job a Reference"

America's troubled waters

This water, like all the other streams, lakes and wells in America, contains problems in every drop.

It must become all things to all men.

To thirsty America, it must become pure.

To food-processing America, it must become soft, free of magnesium or calcium salts.

To boiler-operating America, it must become non-corrosive, non-scaling.

To highly technological America, it must often become so free of minerals that its purity is measured by its resistance to electricity.

And to *all* America, it must become abundant—because we are using it at the rate of 1,333 gallons per person per day.

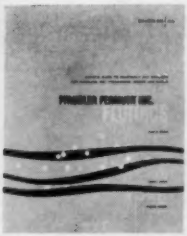
Treating troubled waters is the primary objective of our Permutit Division. At Birmingham, New Jersey, Permutit operates one of the nation's largest water analysis laboratories, checking problem water for industry, municipalities and countless individual home owners. From the desks and drawing boards of a hundred engineers and designers in New York City come Permutit designs and specifications for equipment that will take the problems out of water. And from factories in Lancaster, Pennsylvania and Birmingham, New Jersey comes the equipment to do this job.

FLUIDICS AND YOU. The search goes on, through Fluidics . . . the Pfaudler Permutit program that finds better ways to handle liquids and gases.

How soon will *you* have a water problem? Be ready with the answers. Send for Bulletin 4433, "An Outline of Modern Water Treatment Equipment." Or if you have specific questions, please call your local Permutit field engineer or write directly to the Permutit Division.

Build your FLUIDICS* library

gh-capacity water tening: New Per- tit® Model BD iteners answer in- stry's needs for re soft water at ver cost. Full de- ls on operation, ecifications and rformance are **Bulletin 4696.**

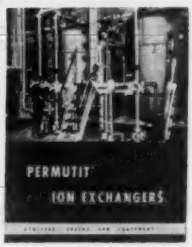


How FLUIDICS works for you: Buyer's Guide surveys equipment for water and waste treatment, ion exchange, gas analysis, metering and control. Also equipment for handling corrosives, heat transfer, reactions, centrifuging and packaging. Send for **Bulletin 992.**

Standard packaged demineralizers: Factory-assembled, systems ready to connect and operate. For summary of applications, plus data on mixed-bed, two-step, non-regenerable and skid-mounted units, send for **Bulletin 4721.**

Automatic valveless gravity filter: Costs up to 45% less than conventional filters. Also saves money after installation, because it operates automatically without a single valve, agitator, pump, flow controller, or an attendant operator. **Bulletin 4351.**

ating industrial stes: Bulletin 86 discusses types industrial waste oblems, equipment d, typical waste atment systems.



Ion exchangers: From Permutit — the only company to manufacture ion exchange resins and the equipment in which they are used — you can get a brief manual on use of ion exchange as a unit process for purification, recovery, addition, separation, concentration. **Bulletin 2508** also covers Permutit resins and equipment.

Permutit® Precipitator: Saves about 50% in ground space, 50%-75% in time of treatment, and 10%-40% in certain chemicals and adsorbents, compared to conventional reaction and settling tank. Complete facts on operation and applications **Bulletin 2204C.**

ter treatment emicals: Permutit ers an extensive e of specialized emicals. Typical n available: **Bulle- CS-105** on Wis- floc-20 Coagulant **, Bulletin CS-111** Neutralizing Am- **s, Bulletin CS-110,** Briquet System.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

Send coupon for Free copies

PFAUDLER PERMUTIT INC.
Permutit Division, Dept. AWD-91,
50 West 44th Street, New York 36, N. Y.
Please send me the following bulletins:

- ☐ 4696 Permutit BD Model Softener
- ☐ 4721 Permutit Packaged Demineralizers
- ☐ 4351 Permutit Automatic Valveless Gravity Filter
- ☐ 2508 Permutit Ion Exchangers
- ☐ 2204C Permutit® Precipitator
- ☐ CS-105 Permutit Wisprofloc-20 Coagulant Aid
- ☐ CS-111 Permutit Neutralizing Amines
- ☐ CS-110 Permutit Briquet System
- ☐ 992 FLUIDICS Buyer's Guide
- ☐ 4486 Equipment for Treating Industrial Wastes

Name.....
Title.....
Address.....
City..... Zone..... State.....

PFAUDLER PERMUTIT INC.
Specialists in FLUIDICS . . . the science of fluid processes

On Call . . .
to tell your story for you!

Willing Water wants work on or as your public relations staff. Let him be your spokesman to your customers . . . to your personnel. You'll find him a master of the art of putting across your ideas . . . of soliciting co-operation . . . of establishing good will. Call him up . . . put him to work on your publicity, your signs, your bulletins, your bills, your reports . . . you'll find him ready, able and, of course, willing.

Low-cost blocked electrotypes or newspaper mats, in different poses, are immediately available to you. Write now for a catalog and price list to:

AMERICAN WATER WORKS ASSOCIATION
2 Park Avenue · New York 16, New York

LaMOTTE SERVICE
to the
Water and Sewage Field
covering

- pH Apparatus and Reagents
- Boiler Feed Water Control
- Residual Chlorine Control
- Swimming Pool Water Control
- Apparatus for Water Analysis

LaMotte Pomeroy Outfit for Determining Sulfide in Sludges and Gases

Standard routine tests developed by the LaMotte Research Department in cooperation with authorities in these fields. LaMotte Outfits are standardized, accurate, inexpensive, and easy to operate.

We will be happy to send full information on LaMotte products used in the Water Works Field.

THE LaMOTTE CHEMICAL PRODUCTS COMPANY
Dept. AWAD Chestertown, Md., U.S.A.

NIGHT AND DAY

twenty-four hour service

PUMPS • WATER WELLS • WATER TREATMENT

Layne knows that an unfailing supply of water is vital, whether it be for municipal, industrial or agricultural use. With Associate Companies located throughout the world, Layne can provide the speed, the trained technicians and the quality parts to remedy your water problem. Over 75 years of experience accounts for the ever increasing list of customers who depend on Layne for service. For service night and day, call the Man From Layne.

Write for Layne Service Bulletin 100.

LAYNE OFFERS COMPLETE WATER SERVICE: Initial Surveys • explorations • recommendations, site selection foundation and soil-sampling • well drilling • well casing and screen • pump design, manufacture and installation • construction of water systems • maintenance and service • chemical treatment of water wells • water treatment—all backed by Layne Research • Layne services do not replace, but coordinate with the services of consulting, plant and city engineers.

LAYNE & BOWLER, INC., MEMPHIS

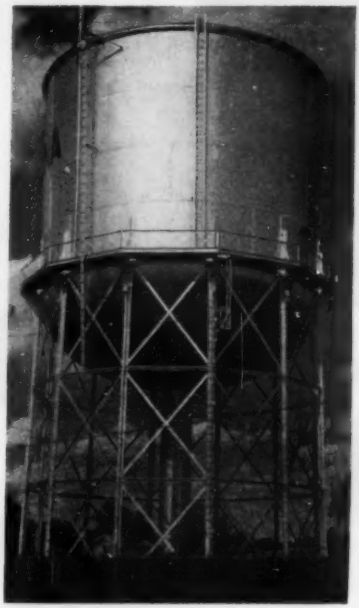
Offices and Factory • Memphis 8, Tennessee

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Sales Representatives in Major Cities

WATER TANK MAINTENANCE

PAINTING



REPAIRING

MODERN METHODS
COMPLETE INSURANCE COVERAGE

WITH PROPER MAINTENANCE,
A WATER TANK WILL LAST
INDEFINITELY

Estimates Furnished Without Obligation

THE K. KESSLER CO., INC.
FREMONT, OHIO

Philadelphia, Pa. Dallas, Tex.

CUT COSTS, SAVE TIME ON UNDERWATER JOBS

Nothing like the new USIFLEX® Boltless Flexible Joint Pipe for underwater installations. No bolts, nuts, wrenches. Assembles fast and easily with only a moderate thrust needed to move ball past self-sealing gasket into socket. Retainer ring provides positive lock against pull-out. Here's the new answer to the old problem of laying underwater pipe quickly, economically, profitably. Get the full story today. Write or call:

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A wholly integrated producer from mines and blast furnaces to finished pipe.

USIFLEX
BOLTLESS FLEXIBLE JOINT* PIPE

*U. S. Patent No. 2,564,939

1 Insert the gasket in its seat in the socket. Forming gasket loop helps initial stage of seating. Release of loop allows gasket to spring into the gasket seat where it is securely held.

2 Apply special Usiflex lubricant to the ball and inside surface of seated gasket in socket. After lubrication, ball is ready to be pushed into socket.

3 Ball has been socketed. Retainer ring lugs have been lined up with recesses in bell and retainer ring is ready to be moved into the bell and rotated.

4 After insertion and rotation of retainer ring in bell, the lugs on retainer ring are in back of and in register with internal flange segments in bell. Lead lock is partially inserted into recess between the bell and retainer ring.

5 Lead lock completely inserted in recess is being caulked in place by hammer blows on a wide caulking iron.

U.S. cast iron **PIPE**

FOR WATER, SEWERAGE AND INDUSTRIAL SERVICE

1879—ROSS—1879

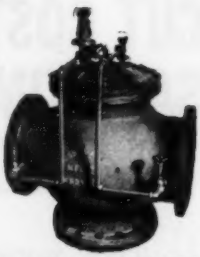
Automatic Valves

ALTITUDE VALVE

Controls elevation of water in tanks, basins and reservoirs

1. Single Acting
2. Double Acting

Maintains safe operating pressures for conduits, distribution and pump discharge



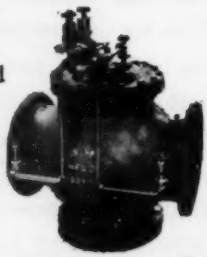
SURGE-RELIEF VALVE

REDUCING VALVE

Maintains desired discharge pressure regardless of change in rate of flow

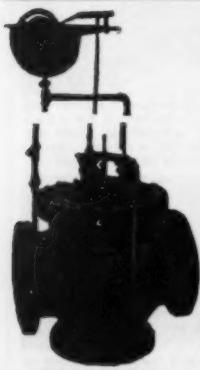
Regulates pressure in gravity and pump systems; between reservoirs and zones of different pressures, etc.

A self contained unit with three or more automatic controls



COMBINATION VALVE

Combination automatic control both directions through the valve.

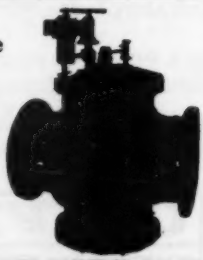


FLOAT VALVE

Maintains levels in tank, reservoir or basin

1. As direct acting
2. Pilot operated and with float traveling between two stops, for upper and lower limit of water elevation.

Electric remote control—solenoid or motor can be furnished



REMOTE CONTROL VALVE

Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

Packing Replacements for all Ross Valves Through Top of Valve

ROSS VALVE MFG. CO., INC., P. O. BOX 593, TROY, N. Y.

Multiple Sources— Extra Reliability!

...when you call on

GENERAL CHEMICAL for ALUM!

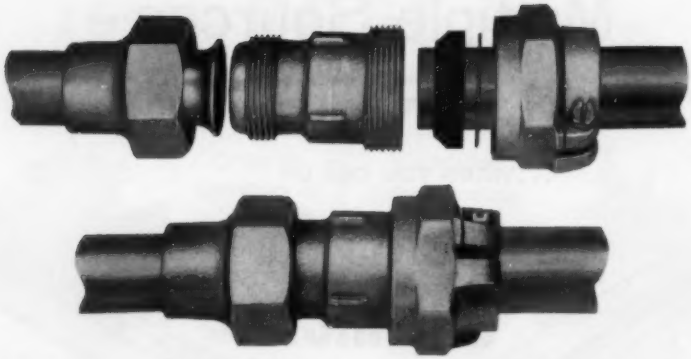
In the Great Lakes region alone, for example, General Chemical has ten plants to serve Alum consumers with speed, efficiency... and certainty. Similar multi-source supply patterns exist in other major consuming areas. Your local General Chemical office will be glad to show you how any of the following alum plants can be put to work for you:

Atlanta, Ga. • Barnet, B. C.* • Chillicothe, O. • Cleveland, O. • Denver, Colo. • Detroit, Mich. • E. St. Louis, Ill. El Segundo, Calif. • Hopewell, Va. • Jacksonville, Fla. • Johnsonburg, Pa. • Kalamazoo, Mich. • Kennewick, Wash. • Macon, Ga. • Marcus Hook, Pa. • Menasha, Wis. • Middletown, O. • Monroe, La. • New Orleans, La. Pine Bluff, Ark. • Port Arthur, Ont.* • Port St. Joe, Fla. • San Francisco (Port Chicago) Calif. • Savannah, Ga. Tacoma, Wash. • Thorold, Ontario* • Vancouver, Wash. • Wisconsin Rapids, Wis. • Valleyfield, Quebec*

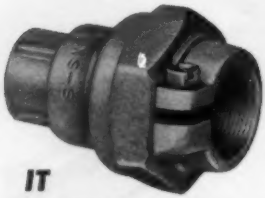
Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

*In Canada: Allied Chemical Canada, Ltd.



Connect copper service to old lead pipe . . . *quickly, easily!*



IT GRIPS . . .

Holds under pressures many times those encountered.

SIZES

For flared or solder connection of copper to Lead Pak on ½", ⅝", ¾" or 1" lead pipe in strong, extra strong or double extra strong types.

with the

FORD Lead-Pak Coupling

Do you have old lead pipe services? You can now connect copper tubing to lead pipe easily, quickly and dependably with the Ford Lead-Pak Coupling. No heat, no flanging, no disturbing of the old lead pipe except for cutting with a saw and cleaning.

These simple bronze couplings are made for either solder or flare connection to copper in the various sizes listed. Write for prices and complete information.

FORD

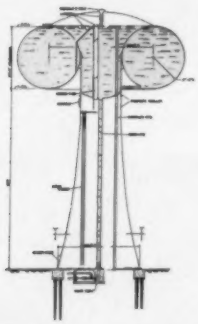
THE FORD METER BOX COMPANY, INC.
Wabash, Indiana

FOR BETTER WATER SERVICES

NEW FROM GRAVER...

for elevated water storage

The Graver Aquatore is the first new design for almost a quarter century. This new form is an improvement over the radial-cone bottom design for large-capacity storage. The advantages are impressive: lower head range, unitary foundations, housing of pumping equipment within the column, simplified maintenance (absence of multiple columns, tie-rods, etc.) and clean appearance. The distinctive design typifies a modern, progressive community.



THE AQUATORE

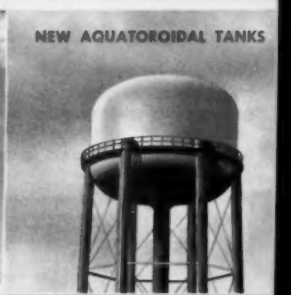
CAPACITIES AND DIMENSIONS

Capacity in Gallons	Tower Height to Low Water Level	Anchor Bolt Circle Diameter	Head Range	Torus Outside Diameter
3,000,000	100′	54′-6″	42′-0″	120′-3″
2,500,000	100′	52′-6″	39′-6″	112′-11″
2,000,000	100′	49′-6″	37′-0″	105′-0″
1,500,000	100′	46′-6″	34′-0″	94′-8″
1,000,000	100′	42′-0″	29′-6″	83′-6″
750,000	100′	39′-6″	26′-6″	75′-9″
500,000	100′	36′-6″	23′-0″	66′-9″
400,000	100′	34′-6″	21′-0″	62′-0″
300,000	100′	32′-6″	19′-0″	57′-0″

STANDARD FROM GRAVER

Capacity Gallons	Diameter	Head Range	Number of Columns
25,000	18′-0″	13′-9″	4
30,000	18′-0″	16′-6″	4
40,000	20′-0″	17′-10″	4
50,000	22′-0″	19′-0″	4
60,000	24′-0″	19′-0″	4
75,000	26′ 0″	21′-0″	4
100,000	28′-0″	23′-9″	4
125,000	30′-0″	25′-9″	4
150,000	32′-0″	27′-11″	4
200,000	36′-0″	29′-11″	4
250,000	40′-0″	29′-2″	5
300,000	44′-0″	30′-0″	5
400,000	50′-0″	30′-0″	6
500,000	55′-0″	30′-0″	7
750,000	61′-0″	40′-0″	8
1,000,000	70′-0″	40′-1″	10
1,500,000	104′-0″	25′-0″	12
2,000,000	112′-0″	30′-0″	16
2,500,000	122′-0″	30′-0″	16
3,000,000	124′-0″	38′-0″	20

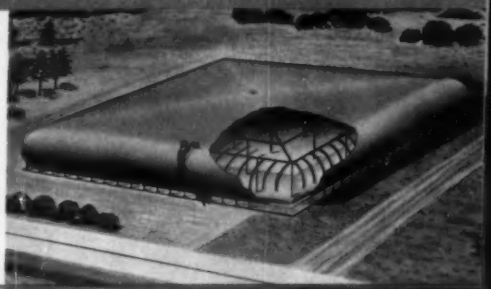
Only STEEL Tanks Meet AWWA Specifications.



. . . other types of water storage tanks from Graver

Graver Cylindroids

New . . . Graver Cylindroids are the newest form of reservoir for large-volume, ground-level water storage. Square or rectangular in plan, Cylindroids offer full use of standard plots and can be built for almost unlimited capacities. These steel reservoirs are functional in design, fully tested and have been developed by Graver for long-lasting service at low cost.



Graver Reservoirs

These large-diameter, ground-level, steel tanks provide large-volume reserve supplies of water. They offer the advantages of inexpensive foundations and easy maintenance, plus high strength and resistance to extreme weather conditions. Built to suit individual water system needs and site characteristics, these reservoirs are, in a sense, custom designed, fabricated and erected. They can be embellished architecturally or can be built below grade and effectively landscaped.

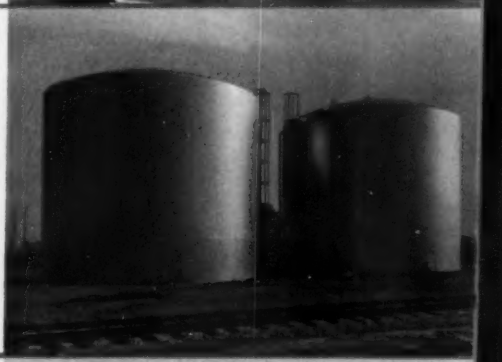
Graver Standpipes

Steel standpipes providing static head for water distribution systems—and often specified where pressure and volume needs exist together—are tanks having a greater height than diameter. Standpipes can be roofed with a variety of designs, and are often provided with architectural features such as colonnades. Since the size and capacity of standpipes depend on the requirements of the water distribution system, special design engineering services, to meet local requirements, are available from Graver.

Graver Pump Suction Tanks

Graver is an approved fabricator of pump suction tanks under the Factory Mutual Fire Insurance Companies specifications. All standard sizes shown in the table have ¼″ bottoms, 3/16″ self-supporting roofs and shells of thickness such that stress does not exceed 15,000 psi.

Rated Capacity Gallons	Actual Capacity Liquid Depth = Height—0″	Diameter	Height
100,000	100,470	27′-0″	23′-11½″
150,000	150,120	28′-6″	31′-11½″
200,000	200,730	33′-0″	31′-10½″
250,000	250,340	37′-0″	31′-7½″
300,000	300,550	42′-0″	29′-6″



Over 100 Years of Craftsmanship in Steels and Alloys

Graver Tank & Mfg. Co.

35 EAST WACKER DRIVE

CHICAGO 1, ILLINOIS

Graver

ONE OF THE UNION TANK CAR COMPANIES

New York • Philadelphia • Edge Moor, Delaware • Cleveland • Detroit • East Chicago, Indiana • Tulsa • Houston • New Orleans • Salt Lake City

Los Angeles • San Francisco • Lockeford, California

ASSOCIATE MEMBERS

The names of firms holding Associate Membership in AWWA are shown in boldface. Persons or firms listed under the headings "Representatives" or "Distributors" are not necessarily members of AWWA. (The absence of such listings need not mean that an Associate Member firm has no representatives or distributors, but merely that the firm did not desire them to be listed.)

A/C Pipe, Inc., 8301 Lansdowne Ave., Upper Darby, Pa.

Ace Pipe Cleaning, Inc., 4000 Truman Rd., Kansas City 27, Mo.

Adams Pipe Repair Products, 2310 Merced Ave., South El Monte, Calif.

Alabama Pipe Co., 20th & McCoy St., Anniston, Ala.

Allied Chemical Corp., General Chemical Div., 40 Rector St., New York 6, N.Y.

Allied Chemical Corp., Plastics & Coal Chemicals Div., 40 Rector St., New York 6, N.Y.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Alward, H. W., Inc., 161 Mt. Airy Rd., Bernardsville, N.J.

American Cast Iron Pipe Co., 2930—16th St. N., Birmingham 7, Ala.

Branch Offices

Ill.: 38 S. Dearborn St., Chicago 3
Minn.: 1043 Plymouth Bldg., Minneapolis 3
Miss.: 916 Walnut St. Bldg., Kansas City 6
N.Y.: 117 Liberty St., New York 6
Tex.: 401 Fidelity Union Life Bldg., Dallas 21

Representatives

Colo.: The Mine & Smelter Supply Co., 3800 Race St., Denver 16
Fla.: Ben F. Crabbe, 2033 S. Division St., Orlando
Ohio: C. A. Armstrong, 2043 Atkins Ave., Cleveland 7
Pa.: J. Thomas Holveck, Box 8564, Pittsburgh 20

American City Magazine, 470 Park Ave. S., New York 16, N.Y.

Branch Offices

Calif.: 1870 Hillhurst Ave., Los Angeles 27
Ill.: 2100 Riverside Plaza, Chicago 6
Ohio: 1814 Superior Bldg., Cleveland 14
Tenn.: Box 186, Lookout Mountain

American Concrete Pressure Pipe Assn., 228 N. LaSalle St., Chicago, Ill.

American Cyanamid Co., Industrial Chemicals Div., 30 Rockefeller Plaza, New York 20, N.Y.

American Foundry & Mfg. Co., 920 Palm St., St. Louis 7, Mo.

Representatives

Colo.: McCoy Sales Corp., 845 Wyandot St., Denver
Ind.: James L. Foster, 2526 W. 14th St., Indianapolis
Miss.: Paul Sterner, 6326 Morningside Dr., Kansas City
N.C.: Lee A. Smith, Box 9093, Charlotte
Tenn.: Al Rathheim & Assoc., Box 4242, Memphis
Tex.: Zeke Tipton, 3822 Ella Lee Lane, Houston

American Marietta Co.; *see* Concrete Conduit Co. and Southern Cement Co.

American Oil & Supply Co., 238 Wilson Ave., Newark, N.J.

American Pipe & Construction Co., 4635 Firestone Blvd., South Gate, Calif.

American Well Works, 100 N. Broadway, Aurora, Ill.

Anaconda American Brass Co., 414 Meadow St., Waterbury 20, Conn.

Armco Drainage & Metal Products, 1001 Grove St., Middletown, Ohio

Automatic Control Co., 999 University Ave., St. Paul, Minn.

B-I-F Industries, Inc., 345 Harris Ave., Providence 1, R.I.

Branch Offices

Calif.: 5430 Jillson St., Los Angeles 22
Calif.: 1766 Locust St., San Francisco
Conn.: 5 Hillside Ave., Rocky Hill
D.C.: 6230—3rd St., N.W., Washington 11
Ill.: 6206 N. Milwaukee Ave., Chicago 46
Ind.: 100 South St., West Lafayette
Kans.: 2108 W. 75th St., Prairie Village
La.: 256 Peachtree Blvd. at Florida, Baton Rouge 6
Mass.: 9 School St., Islington
N.Y.: 2302 Main St., Buffalo 14
N.Y.: 20 Vesey St., New York 7
Pa.: 628 W. Rittenhouse St., Philadelphia 44
Pa.: 225 Commercial Ave., Pittsburgh 15
Tex.: 4519 North Central Expressway, Dallas
Tex.: 2502 North Blvd., Houston
Wis.: 8338-B W. Lisbon Ave., Milwaukee 22

Representatives

Colo.: The Ambler Co., 401 W. Bayaud, Denver 23
Ga.: W. D. Taulman & Assocs., 415 E. Paces Ferry Rd., N.E., Atlanta 5
Ill.: Zimmer & Francescon, 1715 15th Street Pl., Moline
Iowa: D. C. Murphy Co., 840—5th Ave., Des Moines
Mich.: William A. DaLee, Inc., 9190 Roselawn Ave., Detroit 4
Minn.: The Plant Equipment Co., 607 Sexton Bldg., Minneapolis 15
Mo.: Lane Machinery Co., 7th & Market St., St. Louis 1
Mont.: Lefler Eng. Sales, 108 N. 23rd St., Billings
Neb.: Bert Gurney & Assoc., Inc., 504 S. 18th St., Omaha 2
N.D.: Central Supply Co., Airport Rd., Box 1084, Bismarck
Ohio: Barefoot & Case, 10 N. Main St., Chagrin Falls
Ohio: Harry T. Porter Co., 504 Worthington Ave., Cincinnati 15
Ohio: H. R. Bowers Co., 1585 W. 117th St., Cleveland 7
Okla.: Ritzhaupt & Co., 100 Block E. 8th St., Esmond
Okla.: Arduser & Co., Box 3645, Tulsa 23
Tenn.: Engineered Plant Equipment, Inc., 22 S. Second Ave., Memphis 3
Tex.: Lewis Dodson Eng. Co., 75 Hughes St., Amarillo
Tex.: Texas Filter Co., Inc., 300 Blum St., San Antonio 6
Utah: J. Henry Jones Co., 120 Apricot Ave., Salt Lake City 10
Wash.: The Instrument Lab., Inc., 934 Elliott Ave., Seattle 99

Babcock & Wilcox Co., The, 161 E. 42nd St., New York 17, N.Y.

Bacharach, E. W., Inc., 4625 Roanoke Pkwy., Kansas City 12, Mo.

Backflow Eng. & Equipment Co., Box 22096, Los Angeles 22, Calif.

(*Continued from page 131*)

Badger Meter Mfg. Co., 4545 W. Brown Deer Rd., Milwaukee 18, Wis.

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio

Baker, G. M. & Son, Inc., 145 Hosack St., Columbus 7, Ohio

Baker, R. H. & Co., Inc., 2244 E. 37th St., Los Angeles 58, Calif.

Bass, George A., Construction Co., Birmingham Theatre Bldg., Birmingham, Mich.

Beall Pipe & Tank Corp., 12005 N. Burgard St., Portland 3, Ore.

Branch Office

Idaho: 225 Broadway, Boise

Bease-Johnson Co., 3030 Banksville Rd., Pittsburgh 16, Pa.

Bering Co., The, Tank Div., 3530 Singleton Blvd., Dallas 12, Tex.

Bethlehem Steel Co., 701 E. 3rd St., Bethlehem, Pa.

Bingham & Taylor Corp., Nalle St., Culpeper, Va.

Bird-Archer Co., The, 4337 N. American St., Philadelphia 40, Pa.

Bird-Archer Co., Ltd., The, 110—2nd St., Cobourg, Ont.

Brainard, F. S., & Co., 246 Palm St., Hartford 12, Conn.

Representatives

Pa.: Frank S. Brainard, Jr. Co., Aquetong Rd., New Hope

Puerto Rico: Luis F. Caratini & Son, Box 2184, San Juan

South Africa: Dowson & Dobson Ltd., Box 978, Durban

Bristol Co., The, Waterbury 20, Conn.

Brooks Products, Inc., Drawer 112, El Monte, Calif.

Buffalo Meter Co., Inc., 2917 Main St., Buffalo 14, N.Y.

Branch Office

Calif.: 300 N. Gilbert Ave., Fullerton

Buffalo Pipe & Foundry Corp., Box 55, Station B, Buffalo 7, N. Y.

Byron Jackson Pumps, Inc., Box 70, Lawrenceburg, Ind.

Caldwell, W. E., Co., 200 E. Brandeis Ave., Louisville 8, Ky.

Calgon Co., Div. of Hagan Chemicals & Controls, Inc., Box 1346, Pittsburgh 30, Pa.

California Brass Mfg. Co.; *see* Pubco Bronze Div.

Calmet Meter Div., Worthington Corp., 2301 S. Main St., Fort Worth, Tex.

Carborundum Co., The, Perth Amboy, N.J.

Cardox Div. of Chemetron Corp., 840 N. Michigan Ave., Chicago 11

Carson, H. Y., Co., Box 6447, Tarrant Branch, Birmingham, Ala.

Carter, Ralph B., Co., 192 Atlantic St., Hackensack, N.J.

Carus Chemical Co., Inc., 1375 —8th St., LaSalle, Ill.

Cast Iron Pipe Research Assn., 3440 Prudential Plaza, Chicago 1, Ill.

Cathodic Protection Div.; *see* Harco Corp.

Central Foundry Co., The, 932 Broadway, New York 10, N.Y.

Central Steel Tank Co., Box 1742, Wichita, Kans.

Central Telemetering & Control, 128 N. Garfield Ave., Monterey Park, Calif.

Branch Office

N.M.: 2611 Quincy N.E., Albuquerque

Centriline Corp., 140 Cedar St., New York 6, N.Y.

Branch Offices

Calif.: 816 W. 5th St., Los Angeles 17

Ga.: Box 13467, Station K, Atlanta 24

Ill.: 111 W. Monroe St., Chicago 3

Mass.: 147 Medford St., Boston 29

Pa.: 1 Belmont Ave., Bala-Cynwyd

Chain Belt Co., 4701 W. Greenfield Ave., Milwaukee 1, Wis.

Branch Offices

Calif.: 2940—7th St., Berkeley 10

Calif.: 8300 Rex Rd., Pico Rivera

Fla.: 1641 Haswell St., Jacksonville

Ga.: 1788 Ellsworth Industrial Dr., Atlanta

Ill.: 2701 W. Peterson Ave., Chicago 45

Ill.: 1630—5th Ave., Box 353, Moline

Md.: 1115 E. 30th St., Baltimore 18

Mass.: 10 High St., Boston 10

Mass.: 32 Park St., Springfield 5

Mich.: 10600 Puritan Ave., Detroit 38

Minn.: 3033 Excelsior Blvd., Minneapolis 16

Mo.: 406 W. 34th St., Kansas City 11

Mo.: 8000 Bonhomme, St. Louis 5

N.J.: 19 N. Harrison St., East Orange

N.Y.: 1807 Elmwood Ave., Buffalo 7

N.Y.: 19 Rector St., New York 6

N.C.: 300 Clanton Rd., Box 3732, Dilworth Sta., Charlotte 3

Ohio: 10488 Chester Rd., Woodlawn, Cincinnati

Ohio: 550 Terminal Tower Bldg., Cleveland 13

Ore.: 2310 N.W. 24th Ave., Portland 10

Pa.: 4125 Whitaker Ave., Philadelphia 24

Pa.: 300 Mt. Lebanon Blvd., Pittsburgh 34

Tex.: 8601 Soverign Row, Box 10167, Dallas 7

Tex.: 2333 Gulf Terminal Dr., Houston 23

Utah: 10 Exchange Pl., Salt Lake City

Wash.: 2425 Airport Way, Seattle 4

Wis.: 103 W. College Ave., Appleton

Wis.: 4532 W. Greenfield Ave., Milwaukee 14

Distributors

Ala.: S. L. Morrow Eng. Co., 113 N. 9th St., Birmingham 4

Mich.: L. H. Flaherty Co., 638 Griggs St., S.E., Grand Rapids

Charles Machine Works, Inc., 1959 W. Fir Ave., Perry, Okla.

Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago 4, Ill.

Branch Offices

Ala.: 1500 N. 50th St., Birmingham 1

Calif.: 712 Fair Oaks Ave., S. Pasadena

Calif.: 100 Bush St., San Francisco

Ga.: Healey Bldg., Atlanta 3

La.: Pan American Life Bldg., New Orleans 19

Mass.: 50 Franklin St., Boston 10

Mich.: Lafayette Bldg., Detroit 26

Mo.: 7928 State Line Rd., Kansas City 14

N.Y.: 165 Broadway, New York 6

Ohio: 309 Republic Bldg., Cleveland 15

Okla.: 2651 E. 21st St., Tulsa

Pa.: 6 Penn Center Plaza, Philadelphia 2

Pa.: Porter Bldg., Pittsburgh 19

Tex.: C & I Life Bldg., Houston 2

Utah: 550 W. 17th South St., Salt Lake City

Wash.: Henry Bldg., Seattle 1

Chicago Pump Co., 622 W. Diversey Pkwy., Chicago 14, Ill.

Christy Concrete Products, Inc., Forni Div., 6150 Hollis St., Everyville, Calif.

Cla-Val Co., 17th & Placentia, Newport Beach, Calif.

Clow, James B., & Sons, Inc., 201 N. Talman Ave., Chicago 80, Ill.

Coastal Chemical Co., Inc., Savannah, Ga.

Cochrane Div., Crane Co., 3124 N. 17th St., Philadelphia 32, Pa.

Combination Pump Valve Co., 851 Preston St., Philadelphia 4, Pa.

Concord Chemical Co., Inc., 205 S. 2nd St., Camden, N.J.

Concrete Conduit Co., Div. of American Marietta Co., 1371 So. LaCadena Ave., Colton, Calif.

Branch Offices

Alaska: Box 97, Anchorage

Alaska: Box 378, Fairbanks

Ariz.: Box 2670, Phoenix

Calif.: Box 6146, Calipatria

Calif.: Box 510, Chico

Calif.: Box 128, Dixon

Calif.: 4150 N. Brawley Ave., Fresno

Calif.: Box 727, Healdsburg

Calif.: Box 77, Irwindale

Calif.: Box 512, Yuba City

Nev.: Box 755, Henderson

Nev.: Box 798, Sparks

Ore.: 2841 N. Columbia Blvd., Portland

Wash.: 7401—8th Ave. S., Seattle

Wash.: 2601 Dakota St., Spokane

(*Continued on page 134*)

TAMPERPROOF

The only Meter Register that cannot be removed or turned back

There is no way the registration of these meters can be shorted. The sealed register is inaccessible. A metal shield protects the magnetic coupling against all external electric forces. Even if dismantled, the meter won't work without the register and the register won't turn without the meter. Let our representative demonstrate how you can foil meter tamperers and stop losing important revenue. Write Rockwell Manufacturing Company, Dept. 163-H, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

Imitated but never equalled

*Trade Mark

SEALED REGISTER* METERS,
another fine product by
ROCKWELL

(*Continued from page 132*)

Concrete Products & Roofing Co., 4523 1st Ave. N., Birmingham 12, Ala.

Consolidated Chemical Industries Div., Stauffer Chemical Co., Suite 300 S., 6910 Fannin St., Houston 25, Tex.

Consolidated Western Steel Div., U. S. Steel Corp., Box 2015, Terminal Annex, Los Angeles 54, Calif.

Branch Offices

Ariz.: 210 S. 51st Ave., Phoenix
Calif.: 1215—20th St., Box 1200, Bakersfield
Calif.: 2421 California Ave., Box 3200, Fresno
Calif.: 120 Montgomery St., San Francisco 4
Utah: Box 96, Salt Lake City 10
Wash.: 1729 Exchange Bldg., Seattle 4

Continental-Fremont, Inc., 1620 Sycamore St., Fremont, Ohio

Continental Products of Texas, 501 Phillips Bldg., Odessa, Tex.

Copper & Brass Research Assn., 420 Lexington Ave., New York 17, N.Y.

Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.

Culligan Inc., Northbrook, Ill.

Cutler-Magner Co., 1116 Fidelity Bldg., Duluth 2, Minn.

Branch Office

Minn.: 1325 Rand Tower, Minneapolis

Darby Corp., 1st & Walker Sts., Kansas City 15, Kans.

Darling Valve & Mfg. Co., Foot of Walnut St., Williamsport, Pa.

Dayton Foundry, Inc., Box 8, Hollydale, Calif.

DeLaval Steam Turbine Co., Nottingham Way, Trenton 2, N.J.

DeZurik Corp., Sartell, Minn.

Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, Ohio

Branch Offices

Ill.: 20 N. Wacker Dr., Chicago 6
Mo.: 4246 Forest Park Blvd., St. Louis 8
N.Y.: 99 Park Ave., New York 16
Ohio: 4701 Paddock Rd., Cincinnati 29
Ohio: 421 Hanna Bldg., Cleveland 13
Pa.: 12 S. 12th St., Philadelphia 7
Pa.: 1323 Oliver Bldg., Pittsburgh 22
Tenn.: 1381 Heistan Place, Box 2088, DeSoto Station, Memphis
Tex.: 1006 Main St., Houston 2

Dominion Bridge Co., Ltd., Box 2160, Vancouver 3, B.C.

Dorr-Oliver, Inc., 77 Havemeyer Lane, Stamford, Conn.

Branch Offices

Fla.: 203 Knowel Bldg., Winter Park
Ga.: 900 Peachtree St., N.E., Atlanta
Ill.: 813 Merchandise Mart, Chicago 54
Md.: 2155 Maryland Ave., Baltimore 18

Dow Industrial Service Div., Dow Chemical Co., 20575 Center Ridge Rd., Cleveland 16, Ohio

Dravo Corp., 5th & Liberty Aves., Pittsburgh 22, Pa.

Dresser Mfg. Div., Dresser Industries, Inc., 41 Fisher Ave., Bradford, Pa.

Branch Offices

Calif.: 101 S. Airport Blvd., S. San Francisco
Tex.: 1121 Rothwell St., Houston 2

East Jordan Iron Works, Inc., East Jordan, Mich.

Branch Offices

Ill.: 16524 Dixie Hwy., Markham
Mich.: 2345 Chicago Dr., S.W. Grand Rapids 9
Mich.: 13001 Northend, Detroit, Oak Park 37

Eddy Valve Co., Waterford, N.Y.

Eimco Corp., 420 Peninsular Ave., San Mateo, Calif.

Electro Rust-Proofing Corp., 30 Main St., Belleville 9, N.J.

Ellis & Ford Mfg. Co., Inc., 1100 Coolidge Rd., Birmingham, Mich.

Equipment Engineers Inc., 737 Loma Verde Ave., Palo Alto, Calif.

Representatives

Calif.: Petroleum Solids Control, Inc., 2420 Lewis Ave., Long Beach 6
Colo.: Goble, Sampson & Smith, Inc., 5505 East Evans Ave., Denver 22

Everson Mfg. Co., 214 W. Huron St., Chicago 10, Ill.

Fairbanks Co., The, 2 Glenwood Ave., Binghamton, N.Y.

Fairbanks, Morse & Co., Pumps & Hydraulic Div., 3601 Kansas Ave., Kansas City, Kan.

Farnan Brass Works Co., The, 1104 Center St., Cleveland 13, Ohio

Filtration Equipment Corp., 371 Hollenbeck St., Rochester 21, N.Y.

Fischer & Porter Co., 985 Warminster Rd., Warminster, Pa.

Fisher Research Lab., Inc., 1975 University Ave., Palo Alto, Calif.

Fisher Tank Co., 3rd & Booth Sts., Chester, Pa.

Flexible Inc., 415 S. Zangs Blvd., Dallas, Tex.

Fog-Tite Meter Seal Co., 4609—6th Ave. S., Seattle 8, Wash.

Ford Meter Box Co., The, Wabash, Ind.

Branch Office

N.J.: 718 Redman Ave., Haddonfield

Foxboro Co., The, 38 Neponset Ave., Foxboro, Mass.

Fraser Cement Products Co., 3020 Andrita St., Los Angeles 65, Calif.

Frontier Chemical Co., Box 545, Wichita, Kan.

Gamon Meter Div., Worthington Corp., 296 South St., Newark 5, N.J.

Garlock Inc., 402 Main St., Palmyra, N.Y.

General American Transportation Corp., 135 S. LaSalle St., Chicago 90, Ill.

Branch Offices

Calif.: 900 Wilshire Blvd., Los Angeles 17
Ill.: 135 S. LaSalle St., Chicago 90
N.Y.: 380 Madison Ave., New York 17
Tex: 919 Bank of the Southwest Bldg., Houston 2

General Chemical Div.; *see* Allied Chemical Corp.

General Controls Co., 801 Allen Ave., Glendale 1, Calif.

Branch Offices

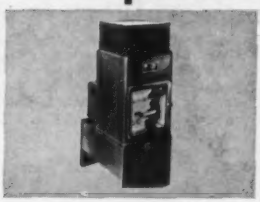
Ariz.: 5115 N. 7th St., Phoenix
Calif.: 801 Allen Ave., Glendale 1
Calif.: 8371 Beaver Lake Dr., San Diego
Calif.: 600 Bryant St., San Francisco 7
Colo.: 2323 W. 2nd Ave., Denver 23
Fla.: 547 Mandalay Rd., Jacksonville 11
Ga.: 1479 Spring St., N.W., Atlanta 9
Ill.: 8080 McCormick Blvd., Skokie
Ind.: 1520 E. Riverside Dr., Indianapolis 7
Iowa: 608—30th St., W. Des Moines
Kan.: 1335 N. Main, Wichita 3
La.: 501 N. Jefferson Davis Pkwy., New Orleans
Md.: 6201 Eastern Ave., Baltimore 24
Mich.: 15114 Plymouth Rd., Detroit 27
Mich.: Iron Mountain
Minn.: 6522 Walker St., Minneapolis 26
Mo.: 2904 Oak St., Kansas City 8
Mo.: 1330 Hampton Ave., St. Louis 10
Neb.: 610 Keeline Bldg., Omaha 2
N.J.: 1024 Springfield Rd., Union
N.Y.: 474 Niagara Falls Blvd., Buffalo 23
N.Y.: 205 E. 42nd St., New York 17
N.Y.: 317 State Tower Bldg., Syracuse 2
N.C.: Rte. 3, York Rd., Charlotte
Ohio: 934 Hollytree Dr., Cincinnati 38
Ohio: 4137 Chester Ave., Cleveland 3
Ohio: 1219 W. 3rd Ave., Columbus 12
Okla.: 1316 S. Peoria Ave., Tulsa 20
Ore.: 4611 S.E. Boise St., Portland 6
Pa.: Box 276, Fort Washington Industrial Park

(*Continued on page 136*)

FOR EFFICIENT PERFORMANCE...
choose the water treating equipment you need from the complete INFILCO line

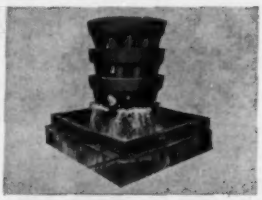
ACCELAPAK® treating plant, complete in a single package for the treatment of surface or well waters in capacities from 15 to 350 g.p.m. Ideal for small communities, industrial plants or institutions.

Bulletin 1870-A.



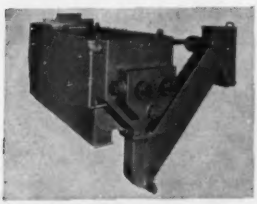
Dry Feeders . . . Type E provide automatic proportional or constant rate feeding. The feeder with linear feed adjustment throughout capacity range of feeder; extrusion type, simultaneous rocking and reciprocal motion of feed pan.

Bulletin 215-D.



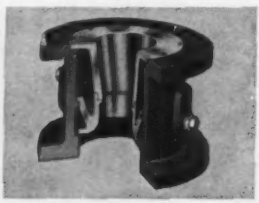
MULTICONE Aerators . . . Low head requirements. Efficient, compact, rugged. Air induction, cascade type. Primary, secondary, and discharge cone assemblies mounted one above the other upon a central inlet pipe.

Bulletin 101-A.



VISCOMATIC® slaker . . . Either high calcium or poor grades of lime are slaked in the form of a paste which is then diluted and fed as lime slurry. High paste temperature results in complete slaking without the need for hot water. Arranged for continuous grit removal.

Bulletin 255-A.



TWIN THROAT Venturi . . . A specially designed venturi tube providing highest accuracy and shortest laying length and the lowest head loss for any given differential. Can be used for metering water, sewage, air or other gases or fluids.

Bulletin 1021.

See your consulting engineer if you are planning any installation. His services are essential for the design of your plant and the selection of equipment that best meets your requirements.

These are only a few of the products for water treatment in the complete INFILCO line which includes equipment to meet your every need.

Write for our condensed catalogs and bulletins.

INFILCO INC. • General Offices • Tucson, Arizona

Field offices throughout the United States and in other countries

Subsidiary of General American Transportation Corp.

INFILCO GENERAL AMERICAN

6011

(*Continued from page 134*)

Pa.: 2 Pkwy. Center, 875 Greentree Rd., Pittsburgh 20
R.I.: Warwick Industrial Park, Warwick
Tenn.: 871 McCallie Ave., Chattanooga 3
Tex.: 1804 N. Industrial Blvd., Dallas 7
Tex.: 3607 S. Sandman St., Houston 6
Tex.: 3804 W. Flagler St., Lubbock
Utah: 2862 S. State St., Salt Lake City 15
Wash.: 925 Westlake Ave. N., Seattle 9
Wis.: 3812 W. Burnham St., Milwaukee 15
Canada:
Alta.: 471—51st Ave., Calgary
Alta.: 8911—88th Ave., Edmonton
B.C.: 1042 Davie St., Vancouver 5
Man.: 1466 Erin St., Winnipeg 12
Ont.: 171 Dawson Rd., Guelph
Ont.: 73 Simcoe St., Toronto 1
Que.: 5165 Sherbrooke St. W., Montreal
England: 13/15 Bowlers Croft, Honywood Rd., Basildon, Essex
Switzerland: 20404 General Controls International S.A., Rue St. Pierre 20, Fribourg
West Germany: Dusseldorf-Reisholz, Thorner Strasse 23, Dusseldorf

General Electric Co., 1 River Rd., Schenectady, N.Y.

General Filter Co., 925—2nd St., Ames, Iowa
Representatives
Ark.: E. J. Richardson, 702 W. 20th St., Pine Bluff
Ark.: Layne-Arkansas Co., 120 W. 2nd St., Stuttgart
Calif.: Norman Gunderman, Box 625, Santa Ana
Ga.: Layne-Atlantic Co., Box 2486, Savannah
Ind.: Layne-Northern Co., Box 299, Mishawaka
Minn.: Layne-Minnesota Co., 3147 California St., N.E., Minneapolis
Mo.: Layne-Western Co., 1010 W. 39th St., Kansas City
N.J.: Layne-New York Co., Box 266, Linden
Ohio: Layne-Ohio Co., 1100 West Town St., Columbus 22
Tenn.: Layne-Central Co., Box 6696, Memphis
Tex.: Layne-Texas Co., Box 9098, Houston 11
Wis.: Layne-Northwest Co., 6005 W. Martin Dr., Milwaukee 13
Canada:
Ont.: International Water Supply, Ltd., 12 Maitland St., London

Gifford-Hill-American, Inc., Box 4335, Station A, Dallas 8, Tex.

Glamorgan Pipe & Foundry Co., Drawer 740, Lynchburg, Pa.
Branch Offices
Ill.: 122 S. Michigan Ave., Chicago 3
N.Y.: 116 John St., New York 38

Glenfield & Kennedy, Ltd., Low Glencairn St., Kilmarnock, Ayrshire, Scotland

Globe Linings, Inc., Box 7396, Long Beach 7, Calif.

Golden-Anderson Valve Specialty Co., Inc., 1232 Ridge Ave., Pittsburgh 33, Pa.

Goodall Rubber Co., Whitehead Rd., Trenton, N. J.

Gowen, Howerton, Co., Inc., E. 11th St., Roanoke Rapids, N.C.
Branch Office
Va.: Bainbridge Blvd., South Norfolk

Graver Tank & Mfg. Co., Div. of Union Tank Car Co., 35 E. Wacker Dr., Chicago 1, Ill.

Graver Water Conditioning Co., Div. of Union Tank Car Co., 216 W. 14th St., New York 11

Greenberg's, M., Sons, 765 Fulsom St., San Francisco 7, Calif.

Gregg Co., Inc., The, Box 149, Riverton, N.J.
Representative
N.J.: P. S. Wilson, 325 Washington St., Glen Ridge

Griffin Pipe Div., Griffin Wheel Co., 2601—9th Ave., Council Bluffs, Iowa
Branch Offices
Colo.: 1400 W. Evans Ave., Denver 9
Ill.: Green St. & Country Line Rd., Bensenville
Kan.: 1134 S. 12th St., Kansas City 5
Minn.: 941 Johnson Pkwy., S. Paul 6

Gulf-Seal Corp., 1522 Melrose Bldg., Houston 2, Tex.

Gunite Assocs., Inc., 408 N. Midler Ave., Syracuse 6, N.Y.

Hach Co., Box 597, Ames, Iowa

Hagan Chemicals & Controls, Inc.; *see* Calgon Co.

Halliburton Co., Drawer 1431, Duncan, Okla.
Branch Offices
Calif.: 1709 W. 8th St., Los Angeles 17
Colo.: 1130 Petroleum Club Bldg., Denver
Ind.: 208 N.W. 3rd, Berendes Bldg., Evansville
Kan.: 410 Union Center Bldg., Wichita 2
La.: 820 Oil & Gas Bldg., New Orleans 12
La.: 405 Petroleum Tower, Shreveport
Okla.: 2305 Liberty Bank Bldg., Oklahoma City
Tex.: 701 Wilson Tower, Corpus Christi
Tex.: 211 N. Ervay, Dallas 1
Tex.: 411 Esperson Bldg., Houston 2
Tex.: 505 Great Plains Life Bldg., Lubbock
Tex.: 1227 Petroleum Life Bldg., Midland

Hammarlund Automation Div., Telechrome Mfg. Corp., 185 Dixon Ave., Amityville, N.Y.

(*Continued on page 138*)

Harco Corp., Cathodic Protection Div., 4600 E. 71st St., Cleveland 25, Ohio
Branch Offices
Calif.: 202 N. Hawthorne Blvd., Hawthorne
Ga.: Box 528, Decatur, Ga.
Ill.: 7665 N. Sheridan Rd., Chicago 26, Ill.

Hays Mfg. Co., 801 W. 12th St., Erie, Pa.

Healy-Ruff Co., 2255 University Ave., St. Paul 14, Minn.

Hellige, Inc., 877 Stewart Ave., Garden City, N.Y.

Hersey-Sparling Meter Co., 250 Elm St., Dedham, Mass.
Branch Offices
Calif.: 508 S. Monterey Pass Rd., Monterey Park, Los Angeles
Calif.: 225 N. Temple City Blvd., El Monte, Los Angeles
Calif.: 1290 Bayshore Highway, Burlingame, San Francisco
Colo.: 1690 Milwaukee St., Denver 6
Ga.: 101 Marietta St. Bldg., Atlanta
Ill.: 4935 W. Belmont Ave., Chicago 41
Ill.: 1120 Consumers Bldg., Chicago 4
Mass.: 250 Elm St., Dedham, Mass.
Mo.: 807 Waldheim Bldg., Kansas City 6
N.J.: 650 1st Ave. W., Roselle
N.Y.: 50 Church St., New York 7
Ohio: 303 Marion Bldg., 1276 W. 3rd St., Cleveland 13
Ore.: 3322 N.W. 35th Ave., Portland 10
Pa.: 5068 McKean Ave., Philadelphia 44
Tex.: 3191 Commonwealth Dr., Dallas 7
Wash.: 904A Elliott Ave. W., Seattle 99

Hill-Hubbell Co., 3091 Mayfield Rd., Cleveland 18, Ohio

Homelite Div. of Textron Inc., 70 Riverdale Ave., Port Chester, N.Y.

Hooker Chemical Corp., 15 Iroquois St., Niagara Falls, N.Y.

Howard Supply Co., 5125 Santa Fe Ave., Los Angeles 58, Calif.

Hungerford & Terry, Inc., 226 Atlantic Ave., Clayton, N.J.

Hunt, Rodney, Machine Co., 102 Lake St., Orange, Mass.

Hupp Aviation Co., 6632 W. 65th St., Chicago 38, Ill.

Hydraflo, Inc., 495 S. 4th St., Beaumont, Tex.

Hydraulic Development Corp., 18 Canal St., W. Medford 55, Mass.

Hydraulic Supply Mfg. Co., 7500—8th Ave. S., Seattle 8, Wash.

Independent Fitting Co., The, 2241 N.W. York St., Portland 10, Ore.

Industrial Chemical Sales Div., West Virginia Pulp &

Before you buy any storage tank..

take a look at

No matter what your storage problem, a prestressed concrete tank offers many immediate and long term advantages. Minimum maintenance, longest service life, lowest overall cost, 75% of construction cost is spent locally. Modern in engineering and design, proven in service, lowest in cost...prestressed concrete should be considered in any tank planning.

Send for your copy of our new brochure "Prestressed Concrete Tanks."

PRELOAD

PRESTRESSED CONCRETE

THE PRELOAD COMPANY, INC.
355 Lexington Ave., New York 17, N. Y. • Tel.: MUrray Hill 7-0488
1216 Hartford Bldg., Dallas 1, Texas • Tel.: Riverside 8-4047

PRELOAD CONCRETE STRUCTURES INC.
837 Old Country Rd.
Westbury, L. I., N. Y.

THE CANADA GUNITE COMPANY, LTD.
125 Hymus Blvd.
Pointe Claire, P.Q., Can.

HERRICK IRON WORKS
P.O. Box 3007
23450 Clawiter Rd.
Hayward 2, Calif.

(*Continued from page 136*)

Paper Co., 230 Park Ave., New York 17, N.Y.
Branch Offices
Ill.: 35 E. Wacker Dr., Chicago 1
Ohio: 2775 S. Moreland Blvd., Cleveland 20
Pa.: Philadelphia National Bank Bldg., Philadelphia 7

Industrial Paint Co., Haysville Borough, Sewickley, Pa.
Representative
Pa.: O. H. Wilson, Rte. 4, Gettysburg, Pa.

Inertol Co., Inc., 484 Frelinghuysen Ave., Newark 12, N.J.
Branch Offices
Calif.: 27 South Park, San Francisco 7
Ill.: 427 W. Erie St., Chicago 10
N.J.: Junction of Rtes. 70 & 73, Marlton
Representatives
Ala.: L. E. Sturgis, 2550 Beverly Dr., Birmingham 13
Conn.: John Gurtlinger, Taunton Lake Dr., Newtown
Fla.: Florida Specialty Paint Co., 218 W. Adams St., Jacksonville 2
Ga.: C. A. Letz Jr., Box 387, Hapeville
Kan.: Thomas J. Canty, 4618 W. 59th Terrace, Mission
Mass.: Robert B. Patterson, 259 Greendale Ave., Needham Heights 94
Mich.: J. Robert Lee, 320 Shortridge Rd., Rochester
Minn.: Michel Sales Co., 2045 Marshall Ave., St. Paul 4
Mo.: F. S. Crook Co., 1004 Market St., St. Louis 1
N.J.: Donald May, Far Hills
N.Y.: Walter J. Voehringer, 11 Sutherland St., Pittsford
N.C.: Purser & London, Inc., 1317 E. 4th St., Charlotte 4
Ohio: D. I. Cramblette Co., 1861 Wiltshire Rd., Akron 13
Okla.: George Townsend & Co., 1115 Cravens Bldg., Oklahoma City
Pa.: Frank D'Orsie, 2461 Auburn Rd., York
Tex.: C. H. Hartman, Box 4904, Dallas 6
Va.: Earl H. Lee, 2508 Arlington Blvd., Arlington 4

Infilco, Inc., Box 5033, Tucson, Ariz.

International Salt Co., Clarks Summit, Pa.

Iowa Valve Co., Oskaloosa, Iowa

Jacuzzi Bros., Inc., 5327 Jacuzzi Ave., Richmond, Calif.
Branch Offices
Ariz.: 508 E. Buckeye Rd., Phoenix
Calif.: 1949 S. Van Ness Ave., Fresno 21
Calif.: 2202 S. Atlantic Blvd., Los Angeles 22
Calif.: 1560 E. El Camino Ave., Sacramento 15
Calif.: 1136 N. Broadway, Stockton
Colo.: 5065 Colorado Blvd.
Fla.: 4732 S. Orange Blossom Trail, Orlando
Ga.: 690 Murphy Ave. S.W., Atlanta 10
Ill.: 5237 St. Charles, Hillside, Chicago
Ky.: 2114 S. 41st St., Louisville 11
Minn.: 6160 Wayzata Blvd., Minneapolis 16
Mo.: 701 E. 12th Ave., North Kansas City 16
Mo.: 4100 Bayless Ave., St. Louis 23
N.J.: 301 Lodi St., Hackensack
N.Y.: Upper Court St., Binghamton
Ore.: 9510 S.E. McLoughlin Blvd., Portland 22
Tex.: Hwy. 183, Loop 12, Irving (Dallas)
Va.: 1506 Belleville St., Richmond

Jeffrey Mfg. Co., The, 806 N. 4th St., Columbus 16, Ohio

Johns-Manville, 22 E. 40th St., New York 16, N.Y.
Branch Offices
Calif.: Box D, Long Beach 10
Calif.: 116 New Montgomery St., San Francisco 5
Colo.: 1755 Glenarm Pl., Denver 2
Ga.: 101 Marietta St., Atlanta 3
Ill.: Merchandise Mart Plaza, Chicago 54
Mass.: 150 Causeway St., Boston 14
Miss.: 7912 Bonhomme Ave., Clayton, St. Louis 5
N.J.: Manville
Ohio: 3101 Euclid Ave., Cleveland 15
Pa.: Chestnut St. at 4th, Philadelphia 6
Tex.: Box 255, Houston 1
Wash.: 4304 Stone Way, Seattle 3

Johnson, Edward E., Inc., 315 N. Pierce St., St. Paul 4, Minn.

Johnston Pump Co., 3272 E. Foothill Blvd., Pasadena, Calif.
Branch Offices
Idaho: Yellowstone Hwy., Idaho Falls
N.M.: 2007 S.E. Main, Roswell
N.Y.: 30 Rockefeller Plaza, New York 20

Jones, James, Co., 321 N. Temple City Blvd., El Monte, Calif.

Jones Chemicals, Inc., Hardwood Ave., Caledonia, N.Y.
Branch Offices
Calif.: 1904 Border Ave., Torrance
Fla.: 1433 Talleyrand Ave., Jacksonville
Fla.: 14400 N.E. 20th Lane, North Miami
Fla.: 3000—22nd Ave. N., St. Petersburg
Ind.: 600 Bethel Ave., Beech Grove
Mich.: 18000 Payne Ave., Wyandotte
Nev.: Box 179, Henderson
N.Y.: Box 288, Warwick
N.C.: 610 McNinch St., Charlotte
Pa.: 1399 W. 18th St., Erie
Wis.: Box 111, Hudson

Kaiser Engrs., 300 Lakeside Dr., Oakland 12, Calif.
Branch Offices
Ill.: 228 N. LaSalle St., Chicago 1
N.Y.: 200 Park Ave., New York 22
Pa.: 330 Grant St., Pittsburgh 19

Kaiser Steel Corp., Napa, Calif.

Kensbey & Mattison Co., Ambler, Pa.

Kelly Pipe Co., 525 N. Mission Rd., Los Angeles 54, Calif.

Kennedy Valve Mfg. Co., The, 1021 E. Water St., Elmira, N.Y.

Kessler, K., Co., Inc., 410 S. Front St., Fremont, Ohio

Klett Mfg. Co., 179 E. 87th St., New York 28, N.Y.

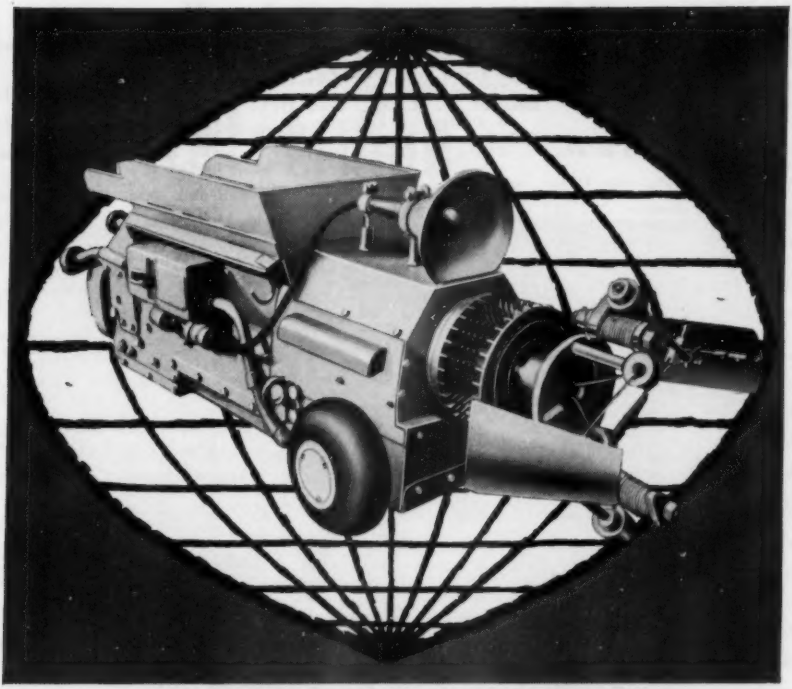
Koppers Co., Inc., Tar Products Div., Koppers Bldg., Pittsburgh 19, Pa.

LaMotte Chemical Products Co., Chestertown, Md.

Lauman, C. W., & Co., Box 235 Bethpage, N.Y.

Layne & Bowler, Inc., 1993 Chelsea Ave., Memphis 8, Tenn.
Branch Offices
Ark.: Layne-Arkansas Co., Box 790, Stuttgart
Colo.: Layne-Western Co., 8301 E. Iliff, Denver
Fla.: Layne-Central Co., 3720 N. Palafox St., Pensacola
Ill.: Layne-Western Co., 721 Illinois Ave., Aurora
Ind.: Layne-Northern Co., Box 299, Mishawaka
Iowa: Layne-Western Co., S. Duff Ave., Ames
Kan.: Layne-Western Co., 1010 W. 39th St., Kansas City
Kan.: Layne-Western Co., 1011 W. Harry St., Wichita
La.: Layne-Louisiana Co., Box DD, Lake Charles
Mass.: Layne New England Co., Box 27, Arlington
Mich.: Layne-Northern Co., 2000 N. Turner St., Lansing
Minn.: Layne-Minnesota Co., 3147 California St., N.E., Minneapolis
Miss.: Layne-Central Co., Box 2387-W. Jackson Sta., Jackson
Neb.: Layne-Western Co., 4430 Commercial Ave., Omaha
N.J.: Layne-New York Co., Box 266, Linden
N.J.: Layne-New York Co., Box 212, Moorestown
N.Y.: Layne-New York Co., Box 234, New Hyde Park
Ohio: Layne-Ohio Co., 1100 W. Town St., Columbus
Pa.: Layne New York Co., 5655 Bryant St., Pittsburgh
Tenn.: Layne-Central Co., Box 6696, Memphis
Wash.: Layne-Pacific, Inc., 15044 Bothell Way, Seattle 55
Wis.: Layne-Northwest Co., 6005 W. Martin Dr., Milwaukee
Canada:
Ont.: International Water Supply, Ltd., Box 816, London
Ont.: International Water Supply, Ltd., 173 Colborne St., W., Oakville

(*Continued on page 140*)



DEFENSE WEAPON
against the population explosion

CEMENT LINING BY CENTRILINE

More people coming, and that means a booming demand for water. Mains **must** carry new loads. The Centriline process helps assure full carrying capacity at all times.

Centriline crews, working on pipes **in place**, clean then line them with a smooth coat of cement mortar. The machine shown above sprays and trowels the new lining, in specified thicknesses up to ⅜", for mains as large as 24". Other Centriline machines can revive old pipe up to twelve feet in diameter.

Centrilining means no more tuberculation or corrosion, and a carrying capacity often greater than when the pipes were new. Of course, Centrilining can be accomplished at a small fraction of the cost of laying new pipe.

Send now for our illustrated brochure which explains the process and shows how Centrilining can help save lines that might otherwise have to be replaced.

CENTRILINE CORPORATION

140 CEDAR STREET • NEW YORK 6 • N.Y. • WOrth 2-1429

A Subsidiary of Raymond International Inc.

Branch Offices in Principal Cities of the United States, Canada and Latin America

(*Continued from page 138*)

Que.: International Water Supply, Ltd., 6070 Sherbrooke St., W., Montreal
Sask.: International Water Supply, Ltd., 122—1st Ave. N., Saskatoon

Representatives

Ariz.: Bews & Co., 4513 E. Avalon Dr., Phoenix
Dela.: Mechem Co., Box 1281, Wilmington
Fla.: R. A. Litkenhaus Co., 11 Florida Ave., Jacksonville
Ga.: Thermal Engineering Co., 314 Buckhead Ave., N.E., Atlanta
Hawaii: Layne Pumps of Hawaii, 2868 Kaihikapu St., Honolulu
Ind.: Avels Sales & Engineering Co., 1407 E. Riverside Dr., Indianapolis
Ind.: Smith-Monroe Co., 1912 S. Main, South Bend
La.: Equitable Equipment Co., 410 Camp St., New Orleans
Mass.: C. R. Swaney Co., 335 Newbury St., Boston 15
Mich.: Coon DeVisser Co., 2050 W. Lafayette Blvd., Detroit
Mich.: Plant Specialties Co., 900 Monroe N.W., Grand Rapids
Minn.: Northwestern Power Equipment Co., 2295 University Ave., St. Paul 14
Mo.: VanDevanter Engineering Co., 2207 Pine St., St. Louis
N.M.: Technical Service Co., Box 131, Albuquerque
N.Y.: McIntosh Equipment Corp., 15 Park Row, New York 38
N.C.: Howard V. Caton Co., 230 N. Torrence St., Charlotte
Ohio: B. W. Rogers Company, Box 1030, Akron
Ohio: Jordan Engineering Co., Box 83, Cincinnati 43
Okla.: Lloyd T. Gibbs Co., Petroleum Bldg., Tulsa
Pa.: J. A. Brown Co., 1616 Walnut St., Philadelphia
Pa.: Harold C. Lusk Co., 929 Park Ave., Pittsburgh 34
Tex.: Robert B. Stockdale Assoc., 3115 Buffalo Dr., Houston
Utah: Douglas Scale & Equipment Co., 3955 S. State St., Salt Lake City

Layne-Atlantic Co., Box 2486, Savannah, Ga.

Branch Offices

Fla.: 1107 Orange Blossom Trail, Orlando
Ga.: Sylvester Rd., Albany
Md.: Governor Ritchie Highway, Glen Burnie
S.C.: Florence Darlington Hwy., Florence
Va.: 3322 Cromwell Rd., Norfolk

Layne Texas Co., 5402 Lawndale Ave., Houston 11, Texas

Branch Offices

Tex.: 4548 N. Baldwin Blvd., Corpus Christi
Tex: 1720 John West Rd., Box 18065, Dallas
Tex.: 5440 Doniphan Dr., El Paso
Tex.: 135 Capitol Bldg., Midland
Tex.: 705 Bryant Petroleum Bldg., Tyler

Lead Industries Assn., 292 Madison Ave., New York 17, N. Y.
Lead Lined Iron Pipe Co., Box 150, Wakefield, Mass.
Leopold, F. B., Co., Inc., 227 S. Division St., Zelienople, Pa.
LeValley McLeod, Inc., 215 E. Church St., Elmira, N.Y.

Branch Offices

N.Y.: 358 Water St., Binghamton
N.Y.: 1624 State St., Olean
N.Y.: 126 VanGuysling Ave., Schenectady
N.Y.: Court St. Rd., Syracuse

Link-Belt Co., Prudential Plaza Bldg., Chicago 1, Ill.
Lock Joint Pipe Co., Box 269, East Orange, N.J.
Lone Star Steel Co., Box 12226, Dallas 25, Tex.
Ludlow Valve Mfg. Co., Inc., Troy, N.Y.
Lynchburg Foundry Co., 620 Court St., Lynchburg, Va.

Branch Offices

Ill.: 122 S. Michigan Ave., Chicago 3
N.J.: 1 Engle St., Englewood
Ohio: 3537 Lee Rd., Shaker Heights 20

M-C-G Co., Inc., 4942 N. High St., Columbus 14, Ohio
M & H Valve & Fittings Co., Box 151, Anniston, Ala.
Maintenance Engineering Corp., 3711 Clinton Dr., Houston, Tex.
McCrea Corrosion Engineering Co., Atalissa, Iowa
McDonald, A. Y., Mfg. Co., 12th & Pine Sts., Dubuque, Iowa
McKesson & Robbins, Inc., Chem. Dept., 155 E. 44th St., New York 17, N.Y.
McWane Cast Iron Pipe Co., Box 2601, Birmingham 2, Ala.

Branch Offices

Ill.: 333 N. Michigan Ave., Chicago 1
Mo.: 1006 Grand Ave., Kansas City 6
N.Y.: 80 Broad St., New York 4
Tex.: 3200 Maple Ave., Dallas 4

Michigan Hydrant & Valve Mfg. Co., 8747 Brandt, Dearborn, Mich.
Millipore Filter Corp., Bedford, Mass.

Distributor

Canada:
Ont.: The British Drug Houses (Canada) Ltd., Barclay Ave., Toronto 14

Milwaukee Lead Works, 3139 N. 31st St., Milwaukee 16, Wisc.
Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.
Mississippi Lime Co., 7 Alby St., Alton, Ill.
Morton Salt Co., 110 N. Wacker Dr., Chicago 6, Ill.

Mueller Co., 512 W. Cerro Gordo St., Decatur, Ill.

Branch Offices

Calif.: 2801 E. 12th St., Los Angeles 23
N.Y.: Empire State Bldg., New York 1
Tenn.: 2501 Chestnut St., Chattanooga 1

Multiplex Mfg. Co., 600 Fowler Ave., Berwick, Pa.
Municipal South, The, 218 W. Morehead St., Charlotte 1, N.C.
Nalco Chemical Co., 6216 W. 66th Pl., Chicago 39, Ill.
National Power Rodding Corp., 1000 S. Western Ave., Chicago 12, Ill.
National Tank Maintenance Corp., 1617 Crocker St., Des Moines, Iowa
National Tube Div., U. S. Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa.
National Water Main Cleaning Co., 50 Church St., New York 7
Neptune Meter Co., 19 W. 50th St., New York 20, N.Y.

Branch Offices

Calif.: 5540 E. Harbor St., Los Angeles 22
Calif.: 101 Rollins Rd., Millbrae
Colo.: 3815 Forest St., Denver 7
Ga.: 200 Permalume Pl. N.W., Atlanta 18
Ill.: 4048 W. Taylor St., Chicago 24
Ky.: 320 Eastern Pkwy., Louisville 17
Mass.: 250 Stuart St., Boston 16
Mo.: 25 W. 15th St., North Kansas City 16
N.Y.: 22-22 Jackson Ave., L.I.C. 1
Ore.: 2680 N.W. Thurman St., Portland 10
Pa.: 7 Bala Ave., Bala-Cynwyd
Texas: 315 Cole St., Dallas 7
Canada:
Alta.: 3610 Manchester Rd., Calgary
B.C.: 1711 Franklin St., Vancouver
Man.: 1022 Selkirk Ave., Winnipeg
N.S.: 25 Upper Water St., Halifax
Que.: 3200 Rachel St. E., Montreal

Neumann Co. Contractors, Inc., 946 W. 69th St., Chicago 21, Ill.
Nooter Corp., 1400 S. 3rd St., St. Louis 66, Mo.
Northern Gravel Co., Box 307, Muscatine, Iowa
Ohio Drilling Co., 113—3rd St., N.W., Massillon, Ohio
Olin Mathieson Chem. Corp., Mathieson Bldg., Baltimore 3, Md.
Olsen, E. C., Co., Box 829, Ogden, Utah
Olympic Foundry Co., 5200 Airport Way, Seattle 8, Wash.
Olympic Welding Co., Inc., 3301 —1st Ave. S., Seattle 4, Wash.

(*Continued on page 142*)

new Federal specification for water pipe

Federal Specification INT. SSP-00385
covers Southern Pipe STEELCOR CEMCOTE Water Pipe...cement-mortar lined and reinforced cement-mortar coated welded steel pressure pipe from 4 to 42 inches in diameter for use in water transmission, distribution, and feeder pipelines.....

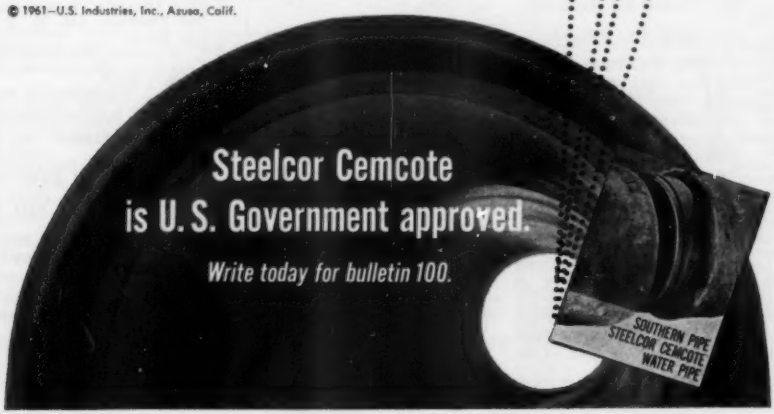
Technical Bulletin 100 Includes:

- complete Federal specification INT. SSP-00385
- Design Tables covering water pressure classes 100 to 400
- Friction Loss Table for nominal pipe diameters (waterways) from 4 to 48 inches and flows from 10 to 100,000 GPM
- a special section on Southern Pipe's exclusive PresSeal Joint with a Deflection Angle table for standard and deep bell PresSeal Joints and an Allowable Radii chart of curvature for various pipe lengths.....

Get your water pipe answers from a Southern Pipe Sales Engineer....

USI **Southern Pipe**
DIVISION OF U.S. INDUSTRIES, INC.
P.O. BOX C • AZUSA, CALIFORNIA • Cumberland 3-7111 – Ellgewood 7-1221

© 1961—U.S. Industries, Inc., Azusa, Calif.



(*Continued from page 140*)

Owens-Corning Fiberglas Corp., National Bank Bldg., Toledo 1, Ohio

P & H Water Works Supply, Inc., 5046 Market St., San Diego 2, Calif.

Pacific Southwest Pipe Co., 6800 Avalon Blvd., Los Angeles 3, Calif.

Pacific States Cast Iron Pipe Co., Box 18, Provo, Utah

Peerless Pump, Hydrodynamics Div., Food Machinery & Chem. Corp., 301 W. Ave. 26, Los Angeles 31, Calif.

Pelican State Lime Corp., Morgan, La.

Penn Meter Co., 4110 Haverford Ave., Philadelphia 4, Pa.

Pennsalt Chemicals Corp., 3 Penn Center, Philadelphia 2, Pa.

Branch Offices

Ga.: College Park Rd., Hapeville, Atlanta
Ill.: 141 W. Jackson Blvd., Chicago 4
Mich.: Box 209, Wyandotte, Detroit
Mo.: 10 S. Brentwood Blvd., St. Louis 5
N.Y.: 400 Park Ave., New York 22
Pa.: 3 Penn Center, Philadelphia 2
Pa.: Natrona, (Pittsburgh)
Wis.: Irving Zuelke Bldg., Appleton

Pennsalt of Washington Div., Pennsalt Chemicals Corp., 2901 Taylor Way, Tacoma 2, Wash.

Pensinger's, 1609 Oak St., Kansas City 8, Mo.

Permutit Co., The; *see* Pfaudler-Permutit Inc.

Pfaudler-Permutit Inc., 50 W. 44th St., New York 36, N.Y.

Branch Offices

Calif.: Rte. 3, Box 131, Carmel
Calif.: 302B S. Brand Blvd., Glendale 4
Colo.: 1485 Holland St., Denver 15
Fla.: Box 34-472, Coral Gables 34
Fla.: 704 Gilmore St., Jacksonville 4
Ga.: 3131 Maple Dr. N.E., Atlanta 5
Ill.: 111 W. Washington St., Chicago 2
Kan.: 7001 W. 76th St., Overland Park
La.: 4543 North Blvd., Baton Rouge 6
Md.: 8605 Cameron St., Silver Spring
Mass.: 50 Kearney Rd., Needham Heights 94
Mass.: 29 Fairfield St., Pittsfield
Mich.: 410 Francis Palms Bldg., Detroit 1
Minn.: 2990 Alabama Ave., St. Louis Park
Mo.: 260 Paul Brown Bldg., St. Louis 1
N.J.: 10 Wilsey Sq., Ridgewood
N.Y.: Box 11, Rochester 1
N.C.: 431½ Walker Ave., Greensboro
Ohio: 2320 Victory Pkwy., Cincinnati 6
Ohio: 1836 Euclid Ave., Cleveland 15
Pa.: 101 N. 33rd St., Philadelphia 4
Pa.: 708 Empire Bldg., Pittsburgh 22
Tenn.: 848 McCallie St., Chattanooga 3
Tex.: 4101 San Jacinto St., Houston 4

Philadelphia Gear Corp., Schuylkill Exprwy., King of Prussia, Pa.

Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.

Pilot Mfg. Co., 20433 Earl St., Torrance, Calif.

Pipe Linings, Inc., Box 457, Wulmington, Calif.

Branch Offices

Calif.: Box 25, Milpitas
Tex.: Box 1202, Ft. Worth

Representative

N.Y.: National Water Main Cleaning Co., 50 Church St., New York 7

Pitt Construction Co., The, 1235 Washington Blvd., Pittsburgh 6, Pa.

Pittman, Wm. G., Co., Inc., 61 Voorhis Lane, Hackensack, N.J.

Pittsburgh Chemical Co., 2027 Grant Bldg., Pittsburgh 19, Pa.

Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh 25, Pa.

Branch Offices

Calif.: Box 2012, El Monte
Calif.: Box 329, Santa Clara
Colo.: 323 Railway Exchange Bldg., Denver 2
Ga.: 361 E. Paces Ferry Rd., N.E., Atlanta 5
Ill.: 679—First National Bank Bldg., Chicago 3
Iowa: 1015 Tuttle St., Des Moines 3
Md.: Box 3459, Curtis Bay Sta., Baltimore 26
N.Y.: 200 E. 42nd St., New York 17
Pa.: Box 660, Warren
Tex.: Suite 1703, Southland Center, Dallas 1
Utah: Box 310, Provo
Wash.: 500 Wall St., Seattle 1

Pittsburgh Plate Glass Co., Chem. Div., 1 Gateway Center, Pittsburgh 22, Pa.

Plastics & Coal Chemicals Div.; *see* Allied Chem. Corp.

Plumb, D. S., Co., Inc., 73 Norfolk St., Newark 3, N.J.

Pollard, Joseph G., Co., Inc., New Hyde Park, N.Y.

Pontex Pipe Corp., 116 John St., New York 38, N.Y.

Portco Corp., Paper & Plastic Div., Vancouver, Wash.

Potter Aeronautical Corp., Rte. 22, Box 1123, Union, N.J.

Branch Offices

Calif.: 23917 Craftsman Rd., Calabasas
Calif.: 5738 Marconi Ave., Carmichael
Ohio: 3898 Linden Ave., Dayton
Okla.: 1341 South Boston, Tulsa
Canada:
Ont.: 465 Wentworth Ave., Ottawa

Representatives

Conn.: Joseph H. Bertram & Co., Inc., 998 Farmington Ave., W. Hartford 7
Mass.: Joseph H. Bertram & Co., Inc., 570 Hillside Ave., Needham Heights 94
Pa.: Arobone & Cline, 33rd & Arch Sts., Philadelphia 4
Utah: Utesco, 130 S. 13th St., Salt Lake City
W.Va.: Process Instrument & Equipment Co., 1904 E. Washington St., Charleston 30

Pratt, Henry, Co., 319 W. Van-Buren St., Chicago 7, Ill.

Branch Offices

Calif.: 3445 W. 8th St., Los Angeles 5
N.Y.: 30 Church St., New York 7

Preload Co., Inc., 355 Lexington Ave., New York 17, N. Y.

Branch Office

Tex.: 1216 Hartford Bldg., Dallas 1

Representatives

Calif.: Herrick Iron Works, Box 3007, Hayward
N.Y.: Preload Concrete Structures, Inc., 837 Old Country Rd., Westbury, N.Y.

Price Bros. Co., 1932 E. Monument Ave., Dayton 2, Ohio

Pubco Bronze Div., California Brass Mfg. Co., 1447 Naud St., Los Angeles 12, Calif.

Public Works Journal Corp., 200 S. Broad St., Ridgewood, N.J.

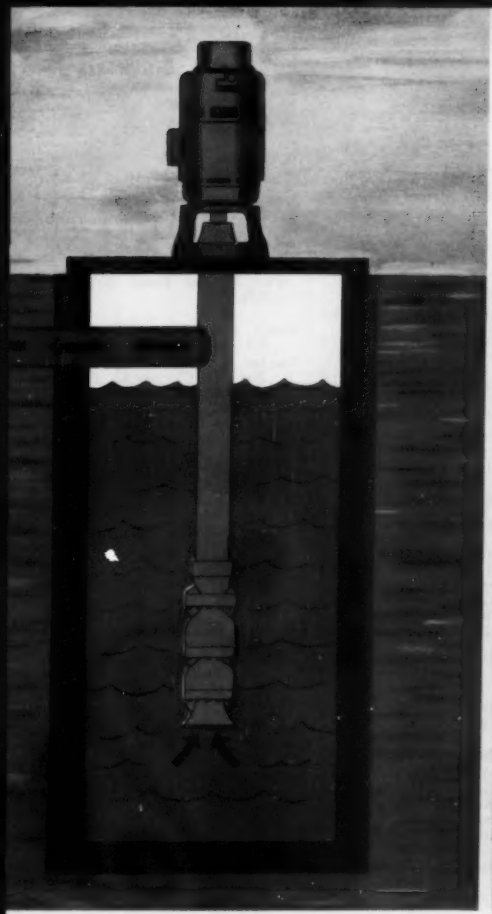
Radio Frequency Lab., Inc., Boonton, N. J.

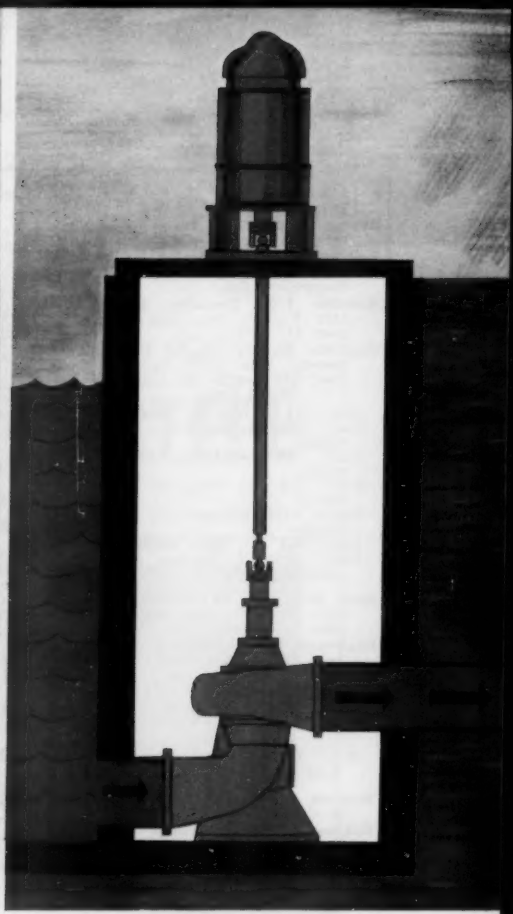
Representatives

Calif.: Luscombe Engineering Co., 1020 S. Arroyo Pkwy., Pasadena, Calif.
Calif.: Luscombe Engineering Co., 3150 E. Cajon Blvd., San Diego
Calif.: Luscombe Engineering of San Francisco, 130 N. B St., San Mateo
Fla.: Dickerson Engineering Sales Co., Inc., 28 Seminole Rd., Atlantic Beach
Ill.: W. L. Cunningham & Assoc., 435 Addison Ave., Elmhurst
N.Y.: The Telesco International Corp., 171 Madison St., New York 16
Ore.: Hawthorne Electronics, 700 S.E. Hawthorne Blvd., Portland 14
Tex.: Data-Trol Co., 5635 Yale Blvd., Dallas 6
Wash.: Hawthorne Electronics, 112 Admin. Bldg., Boeing Field, Seattle 8
Canada:
Ont.: Microwave Systems, 46 Crockford Blvd., Scarborough

Red Hed Mfg. Co., 368 Congress St., Boston 10, Mass.

(*Continued on page 144*)





WET PIT vs DRY PIT?

SELECTION FACTOR	WET PIT	DRY PIT
PUMP FIRST-COST LOWEST		
MOTOR FIRST-COST LOWEST		
LOWER OPERATING POWER COST		
HIGHER SPEED		
MORE EFFICIENT		
LESS SENSITIVE TO WELL DESIGN		
SMALLER PIT AREA		
HEAVIER PIT CONSTRUCTION		
OIL OR WATER LUBE		
SLEEVE BEARINGS		
BALL BEARINGS		
GREASE LUBRICATION		
FEWER SPECIAL PUMP MATERIALS		
LARGER CRANE REQUIRED		

For large capacity pumping for public works or in industry—which installation do you choose? Wet pit (submerged pump) or dry pit (pump surrounded by air)? Frankly, the choice is not clear-cut . . . they both work well.

How do you choose? You must weigh the tangibles (it's fairly easy) and weigh the intangibles (not so easy). At the left are some of the factors which must influence your final selection. Only careful and exhaustive study of all factors bearing on your installation will show you the right choice.

At Worthington we supply pumps for both types of installation so our technical representatives can give you unprejudiced advice. Contact your nearest Worthington District Office. Or write Worthington Corporation, Dept. 105-8, Harrison, N. J. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

(*Continued from page 142*)

Reed Mfg. Co., 1425 W. 8th St., Erie, Pa.

Reeves Rubber, Inc., 415 Avenida Pico, San Clemente, Calif.

Reilly Tar & Chemical Corp., 1615 Merchants Bank Bldg., Indianapolis 4, Ind.

Reliable Iron Foundry Inc., 1583 Fishburn Ave., Los Angeles 63, Calif.

Republic Supply Co. of California, The 2600 Eastland Ave., Los Angeles 54, Calif.

Branch Offices

Ariz.: 251 S. 20th St., Phoenix
Calif.: 3600 Rosedale Hwy., Bakersfield
Calif.: 5400—83rd St., Sacramento
Calif.: 299—9th Ave., San Diego 12
Calif.: 1919 Williams St., San Leandro
Calif.: Box 585, Santa Maria
Calif.: 3608 N. Ventura Ave., Ventura

Rich Mfg. Co. of California, 3851 Santa Fe Ave., Los Angeles 58, Calif.

Rinbrand Well Drilling Co., Inc., 14 Waldron Ave., Glen Rock, N.J.

Branch Office

N.J.: 52 Harristown Rd., Fair Lawn

Distributor

N.J.: Deming Pump Co., 14 Waldron Ave., Glen Rock

Roberts Filter Mfg. Co., 6th & Columbia Ave., Darby, Pa.

Robinson Pipe Cleaning Co., Box 300, Canonsburg, Pa.

Rockwell, W. S., Co., 200 Eliot St., Fairfield, Conn.

Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Branch Offices

Calif.: 3136 E. 11th St., Los Angeles 23
Ga.: 1495 Northside Dr. N.W., Atlanta 1
Ill.: 122 S. Michigan Ave., Chicago 3
Mo.: 1249 Burlington St., North Kansas City 16
N.Y.: 7701 Empire State Bldg., New York 1
Pa.: 390 N. Lexington Ave., Pittsburgh 8
Tex.: 1102 Delano St., Houston 1

Rohan Co., Inc., The, 5000 Franklin Ave., Waco, Tex.

Ross Valve Mfg. Co., Inc., Box 593, Troy, N.Y.

Rust-Oleum Corp., 2425 Oakton St., Evanston, Ill.

Sherman Machine & Iron Works, 26 E. Main St., Oklahoma City 2

Simplex Valve & Meter Co.; *see* Pfaudler-Permutit Inc.

Smith, A. P. Mfg. Co., 545 N. Arlington Ave., East Orange, N.J.

Branch Offices

Calif.: 920 Grayson St., Berkley 2
Calif.: 2024 Merced Ave., El Monte
Ill.: 8 So. Dearborn St., Chicago
Pa.: Morris Bldg., Philadelphia
S.D.: 315 N. Crescent St., Flandreau

Distributors

Fla.: Hughes Supply, Inc., 521 W. Central Ave., Orlando
Kan.: The Collar Co., 2324 Grandview Blvd., Kansas City
Mass.: Sumner & Dunbar, 138 Turnpike St., Canton
Puerto Rico: Luis F. Caratini & Son, Apt. 2184, San Juan 10

Representatives

Ga.: W. E. Scott, 2880 Mockingbird Lane, S.W., Atlanta
Mass.: J. B. Donohoe, 263 Burbank Rd., Longmeadow
N.J.: D. S. Vetromile, 27 Robin Ridge Rd., Upper Saddle River
Okla.: F. A. Arnesen, Box 134-W, Oklahoma City
Pa.: T. H. Kain, 2311 N. Front St., Harrisburg
Pa.: A. G. Scheinert, 727 Penn Ave., Pittsburgh
Tenn.: J. T. Guthrie, 204 Slayton St., Signal Mountain
Va.: L. O. B. Branch Jr., 1321 Andover Rd., Richmond

Smith-Blair, Inc., 525 Railroad Ave., South San Francisco, Calif.

Branch Offices

Calif.: 5635 East Imperial Hwy., South Gate
Pa: Box 647, West Newton Road, Greensburg
Tex.: Waco St., Texarkana

Smith-Scott Co., Inc., 6490 Pedley Rd., Riverside, Calif.

Branch Office

Utah: Box 308, Pleasant Grove

Southern Cement Co., Div. American Marietta Co., Birmingham 3, Ala.

Southern Pipe Div., U.S. Industries, Inc., Box C, Azusa Calif.

Branch Office

Hawaii: Box 1037, Waipahu

Sparkler Mfg. Co., 101 Cartwright Rd., Conroe, Tex.

Specialties Engineering Corp., 1760 E. Washington Blvd., Pasadena, Calif.

Spiniello Construction Co., 249 Wallace St., Orange, N.J.

Standard Electric Time Co., 89 Logan St., Springfield, Mass.

Stauffer Chemical Co.; *see* Consolidated Chemical Industries Div.

Steel Plate Fabricators Assn., Inc., 105 W. Madison St., Chicago 2, Ill.

Steel & Tank Service Co., 308 Clanton Rd., Charlotte 3, N.C.

Branch Office

Tenn.: 3723 Charlotte Ave., Nashville

Stuart Corp., 516 N. Charles St., Baltimore 1, Md.

Branch Offices

Fla.: 523 N. Grandview Ave., Daytona Beach
Va.: Medical Tower Bldg., Norfolk 7

Sumo Pumps, Inc., Brownhouse Rd., Stamford, Conn.

Taylor Forge & Pipe Works, Box 485, Chicago 90, Ill.

Taylor Foundry Co., Box 244, Wichita Falls, Tex.

Tesco Chemicals Inc., 134 Baker St. N.E., Atlanta 12, Ga.

Texas Water Wells Inc., 951 McCarty, Houston 15, Tex.

Thompson Hayward Chemical Co., Box 768, Kansas City 41, Mo.

Branch Offices

Ark.: Box 4085, Asher Sta., Little Rock
Colo.: 1501 W. 13th Ave., Denver 4
Ill.: 2745 W. 21st St., Chicago 8
Iowa: 2040 West River St., Davenport
Iowa: S.W. 1st & Granger Sts., Des Moines 15
Kan.: 5500 Speaker Rd., Kansas City
Kan.: 727 E. Osie, S. Wichita Sta., Wichita 11
La.: 7700 Earhart Blvd., New Orleans 18
La.: Box 1694, Shreveport
Minn.: 909—2nd St. S., Minneapolis 15
Mo.: 5 Carr St., St. Louis 2
Neb.: 1110 S. 4th St., Omaha 8
Okla.: 3909 S. Meridan Ave., Oklahoma City
Okla.: 36 N. Guthrie, Tulsa 3
Tenn.: 1585 Harbor Ave., Memphis 1
Tex.: Box 6226, Dallas 22
Tex.: Box 4557, Houston 13
Tex.: Box 323, Lubbock
Tex.: Box 11126, San Antonio 8

Thomson Meter Corp., 47-25—34th St., Long Island City 1, N.Y.

Traverse City Iron Works, 129 Lake Ave., Traverse City, Mich.

Trinity Valley Iron & Steel Co., 3400 Bryce, Ft. Worth 1, Tex.

Tyler Pipe & Foundry Co., Box 2927, Tyler, Tex.

United Concrete Pipe Corp., Box 425, Baldwin Park, Calif.

Branch Offices

Calif.: Box 486, Napa
Calif.: Box 302, Stockton
Tex.: Box 19283, Industrial Sta., Dallas
Tex.: Box 2868, Odessa
Utah: Box 218, Pleasant Grove
Wash.: Box 467, Auburn

U.S. Lime Products Div., Flintkote Co., 2244 Beverly Blvd., Los Angeles 57, Calif.

Branch Offices

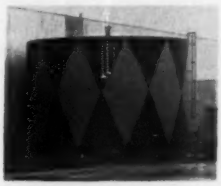
Calif.: 315 Montgomery St., San Francisco 4

(*Continued on page 146*)

RESERVOIRS AND STANDPIPES

OF

STEEL



STANDARD DESIGNS

ORIGINAL TREATMENTS

CODE CONSTRUCTION

LOW COST

FISHER TANK *Company*

CHESTER, PENNSYLVANIA

FIELD ERECTION WORK FROM MAINE TO FLORIDA, AND WESTWARD TO THE MISSISSIPPI.

(*Continued from page 144*)

Utah: 1122 Continental Bank Bldg., Salt Lake City 1
Wash.: 3121 Eastlake Ave., Seattle 2

United States Pipe & Foundry Co., 3300—1st Ave. N., Birmingham 2, Ala.

Branch Offices

Calif.: 1118 Pershing Square Bldg., Los Angeles 13
Calif.: 923 Monadnock Bldg., San Francisco 5
Fla.: 1326 Ceylon Dr., Orlando
Ill.: Box 105, Decatur
Ill.: 923 Peoples Gas Bldg., Chicago 3
Md.: 2434 Maryland Ave., Baltimore 18
Mass.: 250 Stuart St., Boston 16
Minn.: 915 Plymouth Bldg., Minneapolis 3
Mo.: 510 Bryant Bldg., Kansas City 6
N.J.: Burlington
N.M.: 123 Mesa Verde, Santa Fe
N.Y.: 3 E. 44th St., New York 17
N.Y.: 317 State Tower Bldg., Syracuse 2
Ohio: Box 95, Winton Place Sta., Cincinnati 32
Ohio: 20950 Center Ridge Rd., Rocky River 16
Okla.: 1013 N.W. 8th St., Oklahoma City
Ore.: 1238 N.W. Glisan St., Portland 9
Pa.: Jacktown Professional Bldg., Irwin
Tenn.: 3813 Hillsboro Road, Nashville 12
Tex.: 933 Westwood Dr., Abilene
Tex.: 6300 N. Central Expwy., Dallas 6
Tex.: 2742 Bolsover Rd., Houston 5
Wash.: 666 White-Henry-Stuart Bldg., Seattle 1

Universal Construction Co., 1129 Udell St., Indianapolis 23, Ind.

Valley Cities Supply Co., 853 Valley Blvd., San Gabriel, Calif.

Viking Supply Corp., 2625 Elm St., Dallas 26, Tex.

Visi-Meter, Inc., 301 N. 17th St., Kansas City 2, Kan.

Distributors

Mass.: R. H. Smith Supply Co., 593 Wash. St., Lynn
N.Y.: William Herron Co., 213 W. 1st, Oswego

Representative

Ill.: Clyde Hum, 1724 S. Park, Springfield

Vogt Mfg. Co., Box 922, Louisville 1, Ky.

Wachs, E. H., Co., The, 1525 Dayton St., Chicago 22, Ill.

Walker Process Equipment, Inc., 840 N. Russell Ave., Aurora, Ill.

Wallace & Tierman, Inc., 25 Main St., Belleville 9, N.J.

Warren Foundry & Pipe Div., Shahmoon Industries, Inc., 55 Liberty St., New York 5, N.Y.

Water & Sewage Works Magazine (also publish Water & Wastes Digest), 185 N. Wabash Ave., Chicago 1, Ill.

Branch Office

N.Y.: 155 E. 44th St., New York

Water Tank Service Co., Inc., 6115 Denton Dr., Dallas 35, Tex.

Water Works Engineering Magazine, 466 Lexington Ave., New York 17, N.Y.

Branch Office

Ill.: 59 E. VanBuren St., Chicago 5

Water Works Supply Co., Inc., Box 738, Union City, Calif.

Waterous Co., St. Paul 1, Minn.

Watertower Paint & Repair Co., Inc., Clear Lake, Iowa

Welsbach Corp., The, 1500 Walnut St., Philadelphia 2, Pa.

West Virginia Pulp & Paper Co.; *see* Industrial Chemical Sales Div.

Western City Magazine, 440 Statler Center, Los Angeles 17, Calif.

Western Metals Products Co., 409—6th Ave. S.E., Minneapolis 14, Minn.

Westinghouse Electric Corp., 3 Gateway Center, Pittsburgh 22, Pa.

Wheeler, C. H., Manufacturing Co., Pump Div., 19th & Lehigh Ave., Philadelphia 32, Pa.

Branch Office

Ill.: 23 W. Calendar Ave., LaGrange

Wheeler Mfg. Corp., Ross Rd., Ashtabula, Ohio

Whitmire Tank Co., Inc., Box 6493, Jacksonville 5, Fla.

Willamette Iron & Steel Co., 2800 N.W. Front Ave., Portland 10, Ore.

Wood, R. D., Co., 1072 Public Ledger Bldg., Philadelphia 5, Pa.

Representatives

Fla.: R. K. McCord, 1921 Kimbrace Pl., Winter Park
Ill.: T. A. Storms, 2838 S. Chicago Rd., Chicago Heights
N.J.: J. D. Acker, 616 Warwick Rd., Haddonfield
N.J.: A. F. Pleibel, 683 Prospect St., Maplewood
N.J.: R. A. Brown, Box 67, Waldwick
N.Y.: F. D. Perkins, Box 11, Fayetteville
N.Y.: K. O. Hodgson, Box 533, Newtonville, New York
N.Y.: D. C. Squier, Box 3943, Rochester 10
N.C.: F. W. Baker, 3100 Spring Valley Rd., Charlotte 9
Ohio: W. A. West, 219 Edgewood Dr., Berea
Tex.: T. E. Nicholas, 6617 Snider Plaza, Dallas 5

Worthington Corp., Harrison, N.J.

WATER QUALITY AND TREATMENT

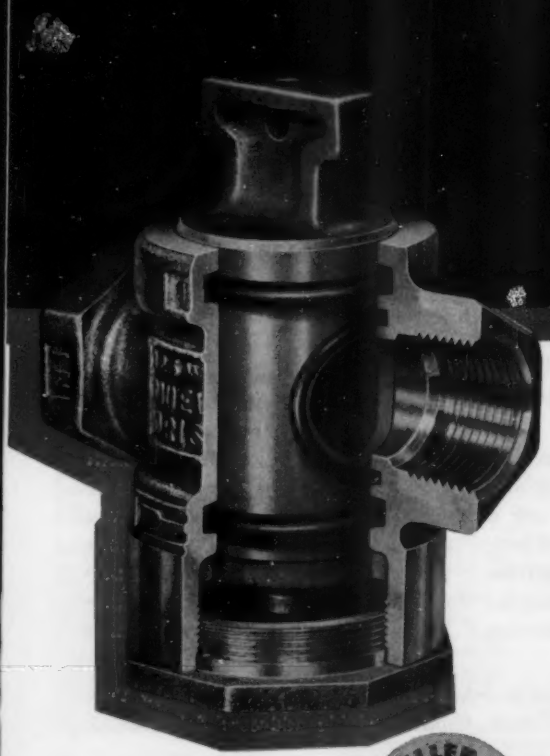
A comprehensive volume, prepared by AWWA, covering water quality standards and procedures for disinfection, coagulation, sedimentation, filtration, odor and corrosion control, and other phases of water conditioning. Completely revised and enlarged second edition (1951); 451 pp.

Price, $5.00

American Water Works Assn., 2 Park Ave., New York 16, N.Y.

MUELLER
ORISEAL
VALVE

THE IDEAL CURB VALVE



LEAKPROOF
pressure sealing "O"-rings provide positive sealing without mechanical seating device.

PERMANENTLY LUBRICATED
Teflon-coated straight plug eliminates periodic maintenance.

EASY TURNING
2" valves at 125 p.s.i. pressure easily operated with 12" wrench — even after prolonged idleness.

PROVEN
20 years of laboratory tests, 12 years of field tests . . . survived 45,000 openings, closings without leaking, changing "O"-rings, or greasing!

See your Mueller representative or write for additional information on the IDEAL curb valve.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited; Sarnia, Ontario

Three County Commissioners from Ohio report:

"For economy and performance, Transite Water Pipe is still our main choice."

"Belmont was one of the many counties that experienced a building and population boom. Fortunately, our officials had the foresight to recognize its ultimate effect on our water system and service. As early as 1953, plans were made to meet future demands. Surveys were made . . . operating men and engineers were consulted . . . pipe materials investigated.

"In 1956, we extended our water system 13 miles. The installation and operating economies are now a matter of record. The successful performance of the extension is attributed to careful planning, helpful advice and, in part, to the selection of Transite Pipe.

Belmont County, Ohio, Commrs. William H. Dorsey, Austin C. Furbee and Louis T. Salvador.

"When we began designing another expansion of the system for 1960, our previous experience made Transite the main choice. The Belmont Water System now has 53 miles of Transite installed in rocky terrain and corrosive soils. The excellent performance of the first 13-mile section leads us to believe that Transite will provide economical maintenance and operation for many years."

For the full Transite® story, write Johns-Manville, Box 362, JA-D, New York 16, N. Y. In Canada: Port Credit, Ontario. Cable address: Johnmanvil.

JOHNS-MANVILLE
TRANSITE PIPE
THE WHITE PIPE THAT PROTECTS PRICELESS WATER

JOHNS-MANVILLE JM PRODUCTS

Water Works Buyers' Guide

This list of products and services has been compiled from checklists submitted by AWWA Associate Members or from past records. Further information about the products of many firms may be obtained from their advertisements (see index on p. 174). The full addresses of the firms listed are given alphabetically in the directory of Associate Members beginning on p. 131.

Abrasives
Carborundum Co., The, Refractories Div.

Acidizing; *see* Well Reconditioning

Activated Carbon
Dow Chemical Co., The
General Filter Co.
Gowen, Howerton, Co., Inc.
Industrial Chemical Sales Div., West Virginia Pulp & Paper Co.
Infilco, Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Activated-Silica Generators
B-I-F Industries, Inc.
Fischer & Porter Co.
Infilco, Inc.
Wallace & Tiernan Inc.

Aerators
American Well Works
Caldwell, W. E., Co.
Carborundum Co., The, Refractories Div.
Chicago Pump Co.
Dorr-Oliver Inc.
Fisher Tank Co.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Layne-Atlantic Co.
Layne Texas Co.
Link-Belt Co.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Vogt Mfg. Co.
Walker Process Equipment, Inc.

Agitators
American Well Works
Bethlehem Steel Co.
Caldwell, W. E., Co.
Dorr-Oliver Inc.
General Filter Co.
Infilco, Inc.
Leopold, F. B., Co., Inc.
Link-Belt Co.
Philadelphia Gear Corp.
Roberts Filter Mfg. Co.
Stuart Corp.
Vogt Mfg. Co.

Air Compressors
Allis-Chalmers Mfg. Co.
Cla-Val Co.
General American Transportation Corp.
Jacuzzi Bros., Inc.
Layne Texas Co.
Minneapolis-Honeywell Regulator Co.
Worthington Corp.

Air Lift Pumping Systems
Walker Process Equipment, Inc.

Alum (Sulfate of Alumina)
Allied Chemical Corp., General Chemical Div.
American Cyanamid Co., Industrial Chemicals Div.
Consolidated Chemical Industries Div.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Ammonia, Anhydrous
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Corp.
Pennsalt Chemicals Corp.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Pioneer Salt Co.
Pittsburgh Plate Glass Co., Chemical Div.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Ammonia, Aqua
Allied Chemical Corp., General Chemical Div.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Pennsalt Chemicals Corp.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Thompson-Hayward Chemical Co.

Ammonia Feeders
Everson Mfg. Corp.
Fischer & Porter Co.
Wallace & Tiernan Inc.

Ammonium Sulfate
American Cyanamid Co., Industrial Chemicals Div.
Bethlehem Steel Co.
Consolidated Chemical Industries Div.
Gowen, Howerton, Co., Inc.
McKesson & Robbins, Inc.
Thompson-Hayward Chemical Co.

Analyzers, Pipeline Network
General Controls Co.
Standard Electric Time Co.

Base Exchange; *see* Ion-Exchange Materials

Bleaching Powder; *see* Chloride of Lime

Blowers
Allis-Chalmers Mfg. Co.
Chicago Pump Co.
General American Transportation Corp.
Homelite Div., Textron, Inc.
Walker Process Equipment, Inc.

Boilers
Babcock & Wilcox Co., The
Dominion Bridge Co.

Books, Record; *see* Meter Reading and Record Books

Boxes; *see* Curb Boxes; Meter Boxes

Brass Goods
American Foundry & Mfg. Co.
Anaconda American Brass Co.
Baker, R. H. & Co., Inc.
Farnan Brass Works Co., The
Ford Meter Box Co., The
Hays Mfg. Co.
McDonald, A. Y., Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Pubco Bronze Div., California Brass Mfg. Co.
Red Hed Mfg. Co.
Rohan Co., Inc., The

Brine-Making Equipment
General Filter Co.
International Salt Co., Inc.
Morton Salt Co.

Business Machines
Minneapolis-Honeywell Regulator Co.

Calcium Fluoride; *see* Fluoride

Calcium Hydroxide; *see* Lime, Hydrated

Calcium Hypochlorite
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Pennsalt Chemicals Corp.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Pittsburgh Plate Glass Co., Chemical Div.

(*See pp. 131–46 for addresses, including branch offices and representatives*)

Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Calcium Oxide; *see* Lime

Calking; *see* Jointing

Carbon; *see* Activated Carbon

Carbon Dioxide

Cardox, Div. of Chemetron Corp.
Olin Mathieson Chemical Corp.

Carbon Dioxide Generators

Infilco, Inc.
Jones Chemicals, Inc.
Walker Process Equipment, Inc.
Wallace & Tiernan Inc.

Castings

Allis-Chalmers Mfg. Co.
American Cast Iron Pipe Co.
American Foundry & Mfg. Co.
Anaconda American Brass Co.
Bethlehem Steel Co.
Chain Belt Co.
Cla-Val Co.
East Jordan Iron Works, Inc.
Hydraflo, Inc.
Independent Fitting Co., The
Jeffrey Mfg. Co., The
Olympic Foundry Co.
Trinity Valley Iron & Steel Co.
Wood, R. D., Co.

Cathodic Protection Equipment

Charles Machine Works, Inc.
Electro Rust-Proofing Corp.
Harco Corp., Cathodic Protection Div.
McCrea Corrosion Engineering Co.
Permutit Co., Inc.
Wallace & Tiernan Inc.
Westinghouse Electric Corp.

Cation Exchange; *see* Ion-Exchange Materials; Softeners

Caustic Soda (Sodium Hydroxide)

Consolidated Chemical Industries Div.
Diamond Alkali Co.
Frontier Chemical Co.
Gowen, Howerton, Co., Inc.
Hooker Chemical Corp.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Pennsalt Chemicals Corp.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Pittsburgh Plate Glass Co., Chemical Div.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Cement

Diamond Alkali Co.
Smith-Scott Co., Inc.
Southern Cement Co.

Cement-Mortar Lining; *see* Coating and Lining, Metal Protective

Chemical Cleaning; *see* Pipe Cleaning

Chemical Feed Apparatus

B-I-F Industries, Inc.
Bird-Archer Co., The
Bird-Archer Co., Ltd., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Cochrane Div., Crane Co.
Fischer & Porter Co.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Leopold, F. B., Co., Inc.
Maintenance Eng. Corp.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Sparkler Mfg. Co.
Wallace & Tiernan Inc.

Chemical Scale Removal Services

Dow Chemical Co., The
Pfaudler Permutit Inc.

Chloride of Lime

Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Thompson-Hayward Chemical Co.

Chlorination Equipment

B-I-F Industries, Inc.
Everson Mfg. Corp.
Fischer & Porter Co.
Layne Texas Co.
Wallace & Tiernan Inc.

Chlorine, Liquid

Consolidated Chemical Industries Div.
Diamond Alkali Co.
Frontier Chemical Co.
Gowen, Howerton, Co., Inc.
Hooker Chemical Corp.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Pennsalt Chemicals Corp.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Pittsburgh Plate Glass Co., Chemical Div.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Chlorine Comparators

Everson Mfg. Corp.
Fischer & Porter Co.
Hach Co.
Hellige, Inc.
LaMotte Chemical Products Co.
Wallace & Tiernan Inc.

Chlorine Dioxide Chemicals

Cardox Div. of Chemetron Corp.
Olin Mathieson Chemical Corp.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Clamps, Pipe Joint

Baker, R. H. & Co., Inc.
Carson, H. Y., Co.
Clow, James B., & Sons
Dresser Mfg. Div.
Michigan Hydrant & Valve Mfg. Co.
Olympic Foundry Co.
Rohan Co.
Smith-Blair, Inc.
Traverse City Iron Works

Clamps, Pipe Repair

Adams Pipe Repair Products
Baker, R. H., & Co., Inc.
Clow, James B., & Sons
Dresser Mfg. Div.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Rohan Co.
Smith-Blair, Inc.

Clarifiers

Carter, Ralph B., Co.
Cochrane Div., Crane Co.
Dorr-Oliver Inc.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Jeffrey Mfg. Co., The
Layne Texas Co.
Link-Belt Co.
Pfaudler Permutit Inc.
Walker Process Equipment, Inc.

Cleaning, Pipe; *see* Pipe Cleaning

Coagulants; *see* Alum; Iron Salts; Polyelectrolytes; Sodium Aluminate; Sodium Silicate

Coagulators

American Well Works
Carter, Ralph B., Co.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Jeffrey Mfg. Co., The
Layne & Bowler, Inc.
Leopold, F. B., Co., Inc.
Link-Belt Co.
Pfaudler Permutit Inc.
Steel & Tank Service Co.
Stuart Corp.
Walker Process Equipment, Inc.

Coating and Lining, Metal Protective: Cement-Mortar

American Cast Iron Pipe Co.
American Pipe & Construction Co.
Beall Pipe & Tank Corp.
Centriline Corp.
National Water Main Cleaning Co.
Pipe Linings, Div. of American Pipe & Construction Co.
Smith-Scott Co., Inc.
Spiniello Construction Co.
United Concrete Pipe Corp.

Coating and Lining, Metal Protective: Coal Tar

Allied Chemical Corp., Plastics & Coal Chemicals Div.
Beall Pipe & Tank Corp.
Dominion Bridge Co.
Hydraulic Supply Mfg. Co.
Koppers Co., Inc.
National Tank Maintenance Corp.
Neumann Co.
Pipe Linings, Div. of American Pipe & Construction Co.
Pittman, William G., Co., Inc.
Pittsburgh Chemical Co.
Reilly Tar & Chemical Corp.

Coating and Lining, Metal Protective: Paint

Bease-Johnson Co.
Continental-Fremont, Inc.
Gregg Co., Inc., The
Industrial Paint Co.
Koppers Co., Inc.
McCrea Corrosion Eng. Co.
National Tank Maintenance Corp.
National Water Main Cleaning Co.
Pipe Linings, Div. of American Pipe & Construction Co.
Pittman, William G., Co., Inc.
Pittsburgh Chemical Co.

(*Continued on page 152*)

1940-1955

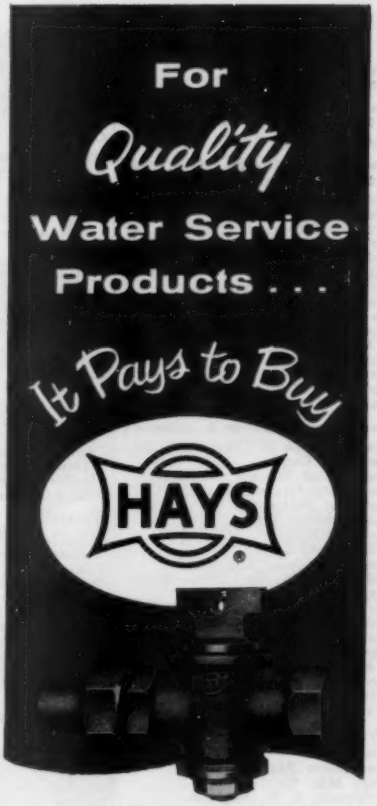
CUMULATIVE INDEX TO THE JOURNAL

These features make the new 16-year Cumulative Index (clothbound, 192 pp.) a time-saving, easy-to-use guide to JOURNAL AWWA for 1940–1955:

- **topic index**—titles of all articles on a particular subject are listed together under the appropriate heading, with cross references to related topics.
- **geographic index**—lists names of places and areas dealt with by articles in detail.
- **author index**—provides a key to all articles by every author during the 16-year period covered.
- **other reference aids**—complete topical outline, alphabetical list of subjects, table of text page numbers for each issue.

List price, $4.50

AMERICAN WATER WORKS ASSOCIATION
2 Park Ave., New York 16, N. Y.



CURB STOPS

•

One of a complete line of Water Service Products

GENERAL PRODUCTS DIVISION
HAYS MFG. CO.
ERIE, PA.

(*See pp. 131–46 for addresses, including branch offices and representatives*)

Rust-Oleum Corp.
Steel & Tank Service Co.

Coating and Lining, Metal Protective: Plastic and Resinous

Specialties Eng. Corp.

Coating and Lining, Metal Protective: Other

Bease-Johnson Co.
Centriline Corp.
Continental-Fremont, Inc.
Gulf-Seal Corp.
Industrial Paint Co.
Koppers Co., Inc.
McCrea Corrosion Eng. Co.
National Tank Maintenance Corp.
Owens-Corning Fiberglas Corp.
Pipe Linings, Div. of American Pipe & Construction Co.
Pittman, William G., Co., Inc.
Pittsburgh Chemical Co.
Smith-Scott Co., Inc.
Steel & Tank Service Co.

Coating and Lining Application

American Pipe & Construction Co.
Centriline Corp.
Consolidated Western Steel Div.
Continental-Fremont, Inc.
Dominion Bridge Co.
Globe Linings, Inc.
Gulf-Seal Corp.
Hill-Hubbell Co.
Hydraulic Supply Mfg. Co.
Industrial Paint Co.
Koppers Co., Inc.
McCrea Corrosion Eng. Co.
National Tank Maintenance Corp.
National Water Main Cleaning Co.
Pipe Linings, Div. of American Pipe & Construction Co.
Steel & Tank Service Co.
United Concrete Pipe Corp.
Watertower Paint & Repair Co., Inc.

Cocks, Curb and Corporation

Crane Co.
Ford Meter Box Co., The
Hays Mfg. Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Red Hed Mfg. Co.
Rohan Co.
Welsbach Corp., The

Compressors; *see* Air Compressors

Condensers

Allis-Chalmers Mfg. Co.
Worthington Corp.

Contractors, Filter Plant

Bacharach, E. W., Inc.
Bass, George A., Construction Co.
Kaiser Engrs.
Layne & Bowler, Inc.
Layne Texas Co.
Leopold, F. B., Co., Inc.
Pitt Construction Co.
Roberts Filter Mfg. Co.

Contractors, Pipeline

Charles Machine Works, Inc.
Consolidated Western Steel Div.
Kaiser Engrs.
Smith-Scott Co., Inc.

Contractors, Well Drilling

Layne & Bowler, Inc.
Layne-Atlantic Co.
Layne Texas Co.
Ohio Drilling Co.
Rinbrand Well Drilling Co., Inc.
Texas Water Wells, Inc.

Controllers, Liquid Level

Automatic Control Co.
B-I-F Industries, Inc.
Bailey Meter Co.
Bristol Co., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Cla-Val Co.
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
General Electric Co.
General Fitter Co.
Hammarlund Automation Div.
Healy-Ruff Co.
Hupp Aviation Co.
Infilco, Inc.
Leopold, F. B., Co., Inc.
Maintenance Eng. Corp.
McCrea Corrosion Eng. Co.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Ross Valve Mfg. Co.

Controllers, Motor and Electric

Allis-Chalmers Mfg. Co.
Automatic Control Co.
Bristol Co.
General Controls Co.
General Electric Co.
Hammarlund Automation Div.
Hupp Aviation Co.
Michigan Hydrant & Valve Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Westinghouse Electric Corp.

Controllers, Pressure

Automatic Control Co.
B-I-F Industries, Inc.
Bailey Meter Co.
Brainard, F. S., & Co.
Bristol Co., The
Cla-Val Co.
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
General Electric Co.
Hammarlund Automation Div.
Healy-Ruff Co.
Hupp Aviation Co.
McCrea Corrosion Eng. Co.
Minneapolis-Honeywell Regulator Co.
Mueller Co.
Penn Instruments Div., Burgess-Manning Co.
Rockwell Mfg. Co.
Ross Valve Mfg. Co.
Wallace & Tiernan Inc.

Controllers, Rate of Flow

B-I-F Industries, Inc.
Bailey Meter Co.
Brainard, F. S., & Co.
Bristol Co., The
Cla-Val Co.
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
Hammarlund Automation Div.
Hupp Aviation Co.
Infilco, Inc.
Leopold, F. B., Co., Inc.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Potter Aeronautical Corp.

Conveyors

Chain Belt Co.
Dominion Bridge Co.
Link-Belt Co.
Stuart Corp.

Copper Sulfate

Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Corrosion Control; *see* Cathodic Protection Equipment; Coating and Lining; Inhibitors; Rust Prevention

Couplings, Split

Baker, R. H., & Co., Inc.
Dresser Mfg. Div.
Jeffrey Mfg. Co., The
Rohan Co.
Smith-Blair, Inc.

Curb Boxes; *see also* Meter Boxes

American Foundry & Mfg. Co.
Bingham & Taylor Corp.
Brooks Products, Inc.
Buffalo Pipe & Foundry Corp.
Central Foundry Co., The
Christy Concrete Products, Inc., Forni Div.
Clow, James B., & Sons
Concrete Products & Roofing Co.
Fraser Cement Products Co.
Hays Mfg. Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Olympic Foundry Co.
Rohan Co., Inc., The
Taylor Foundry Co.
Traverse City Iron Works
Trinity Valley Iron & Steel Co.
Tyler Pipe & Foundry Co.
Welsbach Corp., The
Wood, R. D., Co.

Curb and Corporation Stops

Hays Mfg. Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Red Hed Mfg. Co.
Rohan Co., Inc., The
Welsbach Corp., The

Deaerators

Allis-Chalmers Mfg. Co.
Bird-Archer Co., Ltd., The
Cochrane Div., Crane Co.
Consolidated Western Steel Div.
Dow Chemical Co., The
General Filter Co.
Graver Water Conditioning Co.
Infilco, Inc.
Pfaudler Permutit Inc.

Dechlorinating Agents

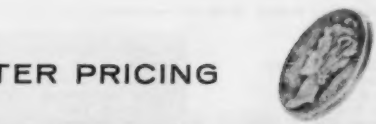
Allied Chemical Corp., General Chemical Div.
Pfaudler Permutit Inc.

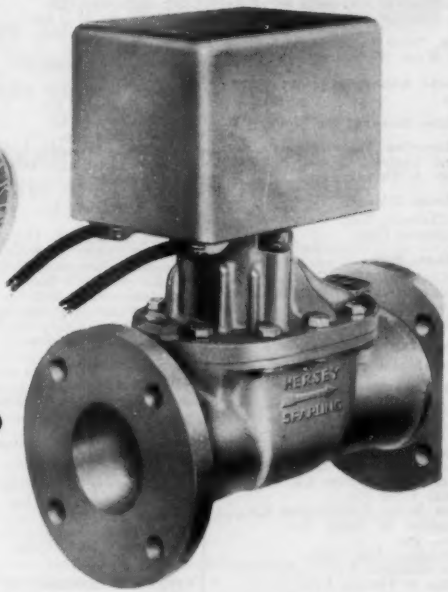
Demineralizers; *see* Ion-Exchange Materials; Softeners

(*Continued on page 154*)

WATER PRICING AND QUANTITY

CONTROL





WITH THE NEW
SPARLING
COIN OPERATED
DISPENSING
METER

Now it is possible for a seller of water to place as many outlets as he likes, in dispensing areas of his choice, and let buyers draw their own water as they need it with no attendant required. Flows are measured accurately. Payment is made on the spot.

The seller has complete control to relate price to quantity depending upon the particular situation. Dial mechanism permits simple presetting of purchase. Coin box receives pre-payment and initiates the delivery. Sparling Main-line meter measures the flow and controls the shut-off. The entire system is simple, compact and foolproof. Get full details from your local Sparling field engineer.

SPARLING
WATER CONTROL EQUIPMENT

HERSEY-SPARLING METER COMPANY

Sparling Equipment, 225 North Temple City Blvd., El Monte, Calif.

Atlanta · Chicago · Cleveland · Dallas · Denver · Kansas City, Mo. · Roselle, N. J. · San Francisco · Seattle
United Kingdom Affiliate: TYLORS OF LONDON LTD.

(See pp. 131–46 for addresses, including branch offices and representatives)

Desalinization Plants
Pfaudler Permutit Inc.
Westinghouse Electric Corp.

Diaphragms, Pump
Carter, Ralph B., Co.
Dorr-Oliver Inc.
Fischer & Porter Co.
Garlock Inc.
Homelite Div., Textron, Inc.
Sparkler Mfg. Co.

Distribution System Analyzers; *see* Analyzers, Pipeline Network

Drills, Well
Texas Water Wells, Inc.

Electric Generators; *see* Generators

Electric Motors; *see* Motors

Engineering Instruments
General Controls Co.
Wallace & Tiernan Inc.

Engines, Diesel
Allis-Chalmers Mfg. Co.
Worthington Corp.

Engines, Gas
Allis-Chalmers Mfg. Co.
Homelite Div., Textron, Inc.
Rockwell Mfg. Co.
Worthington Corp.

Excavating Equipment
Charles Machine Works, Inc.

Feedwater Treatment
Allis-Chalmers Mfg. Co.
Bird-Archer Co., The
Bird-Archer Co., Ltd., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Cochrane Div., Crane Co.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Maintenance Eng. Corp.
Nalco Chemical Co.
Wallace & Tiernan Inc.

Ferric Salts; *see* Iron Salts

Ferrous Salts; *see* Iron Salts

Filter Agitators
Bacharach, E. W., Inc.
Layne & Bowler, Inc.
Leopold, F. B., Co., Inc.
Roberts Filter Mfg. Co.
Stuart Corp.

Filter Bottoms
B-I-F Industries, Inc.
Bacharach, E. W., Inc.
Carborundum Co., The, Refractories Div.
General Filter Co.
Infilco, Inc.
Layne & Bowler, Inc.
Leopold, F. B., Co., Inc.
M-C-G Co.
Pitt Construction Co.
Roberts Filter Mfg. Co.

Filter Media
Bacharach, E. W., Inc.
Dorr-Oliver, Inc.
Filtration Equipment Corp.
General Filter Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Johns-Manville Sales Corp.
Layne & Bowler, Inc.
Leopold, F. B., Co., Inc.
Maintenance Eng. Corp.
Northern Gravel Co.
Owens-Corning Fiberglas Corp.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.

Filter Plant Equipment
American Well Works
B-I-F Industries, Inc.
Bacharach, E. W., Inc.
Bird-Archer Co., Ltd., The
Cla-Val Co.
Cochrane Div., Crane Co.
Dorr-Oliver Inc.
Filtration Equipment Corp.
Fischer & Porter Co.
General Controls Co.
General Filter Co.
Glenfield & Kennedy Ltd.
Hungerford & Terry, Inc.
Hupp Aviation Co.
Infilco, Inc.
Layne & Bowler, Inc.
Layne Texas Co.
Leopold, F. B., Co., Inc.
Michigan Hydrant & Value Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Pfaudler Permutit Inc.
Pitt Construction Co.
Roberts Filter Mfg. Co.
Sparkler Mfg. Co.
Wallace & Tiernan Inc.

Filters, Diatomite
B-I-F Industries, Inc.
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
General Filter Co.
Graver Water Conditioning Co.
Infilco, Inc.
Jacozzi Bros. Inc.
Johns-Manville Sales Corp.
Johnson, Edward E., Inc.
Layne & Bowler, Inc.
Layne Texas Co.
Maintenance Eng. Corp.
Sparkler Mfg. Co.

Filters, Membrane; *see* Membrane Filters

Filters, Pressure
Bacharach, E. W., Inc.
Bird-Archer Co., Ltd., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Cochrane Div., Crane Co.
Dorr-Oliver Inc.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Jacuzzi Bros. Inc.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Sparkler Mfg. Co.

Finders, Pipe; *see* Pipe Locators

Fish Screens; *see* Intake Screens

Fittings; *see* Pipe Fittings

Flocculating Equipment; *see* Coagulators

Flumes
Consolidated Western Steel Div.
Continental-Fremont, Inc.
Dominion Bridge Co.
Filtration Equipment Corp.
Leopold, F. B., Co., Inc.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.

Fluoride Chemicals: Ammonium Fluosilicate
Thompson-Hayward Chemical Co.

Fluoride Chemicals: Calcium Fluoride
Allied Chemical Corp., General Chemical Div.

Fluoride Chemicals: Fluosilicic Acid
Jones Chemicals, Inc.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Thompson-Hayward Chemical Co.

Fluoride Chemicals: Sodium Fluoride
Allied Chemical Corp., General Chemical Div.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Fluoride Chemicals: Sodium Silicofluoride
Allied Chemical Corp., General Chemical Div.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Fluoride Feeders
B-I-F Industries, Inc.
Fischer & Porter Co.
Infilco, Inc.
Wallace & Tiernan Inc.

Furnaces
Pollard, Joseph G., Co., Inc.

Furnaces, Joint Compound
Hydraulic Development Corp.

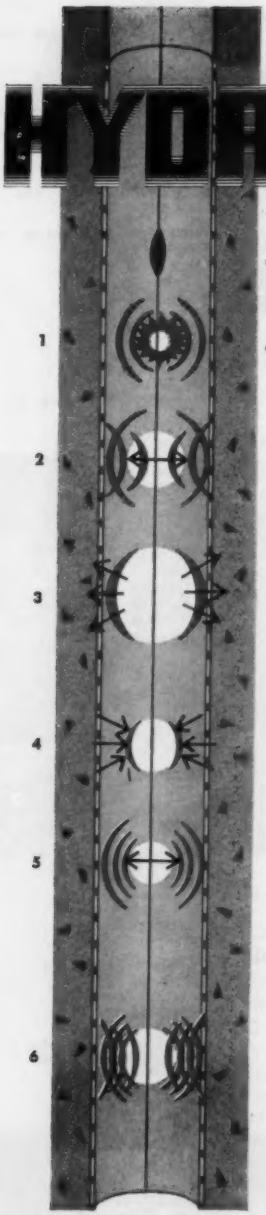
Gages; *see also* Manometers; Meters

Gages, Hydrant Flow
Foxboro Co., The
Michigan Hydrant & Valve Mfg. Co.

Gages, Liquid Level
B-I-F Industries, Inc.
Bailey Meter Co.
Bristol Co., The
Continental-Fremont, Inc.
Foxboro Co., The
General Controls Co.
Infilco, Inc.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Wallace & Tiernan Inc.

Gages, Loss of Head
B-I-F Industries, Inc.
Bailey Meter Co.

(*Continued on page 156*)



HYDRO-SONIC

CLEANS WELL SCREENS . . . WITHOUT PULLING THE PUMP

Amazing results are being obtained by water well owners who use Halliburton's exclusive HYDRO-SONIC water well redevelopment process. The HYDRO-SONIC treatment uses the controlled energy of underwater sonic shock waves to vibrate and help rid well screens of plugging materials which keep water from your well. The entire HYDRO-SONIC job may be performed without pulling the pump, if there is sufficient clearance between pump and well casing . . . requiring only a few minutes for what may give a water well many years of new life. Here is how HYDRO-SONIC works: (1) the charge explodes; (2) the shock waves move out; (3) the gas bubble expands; (4) water pressure compresses the bubble; (5) the cycle starts over again; and (6) the shock wave repeats itself several times.

If rejuvenation is what your well needs, contact a Halliburton HYDRO-SONIC man *today!*

HALLIBURTON is also your *most experienced source* of these other water well services:

- CASING PATCH — helps repair casing leaks with plastic patches while casing is in place.
- SQUEEZE CEMENTING — helps shut-off unwanted water.
- ACIDIZING — helps enlarge flow channels in limestone formations.
- HYDRAULIC FRACTURING — fast growing technique of increasing flow channels in sand formations.

These services are available to you, your drilling contractor, or pump dealer.

Have a Halliburton man discuss your water well problems with you. From the early planning through the completion of your well, his guidance can mean greater yields and longer trouble-free life for your underground water supply.

WATER WELL SERVICES

Dedicated through research and performance to better service for America's water wells

Halliburton
COMPANY · DUNCAN, OKLAHOMA

(*See pp. 131–46 for addresses, including branch offices and representatives*)

Bristol Co., The
Fischer & Porter Co.
Foxboro Co., The
General Filter Co.
Infilco, Inc.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.

Gages, Pressure and Vacuum

B-I-F Industries, Inc.
Bailey Meter Co.
Brainard, F. S., & Co.
Bristol Co., The
Foxboro Co., The
General Controls Co.
Michigan Hydrant & Valve Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Rockwell Mfg. Co.
Wallace & Tiernan Inc.

Gages, Rate of Flow

B-I-F Industries, Inc.
Bailey Meter Co.
Brainard, F. S., & Co.
Bristol Co., The
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
General Filter Co.
Infilco, Inc.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Potter Aeronautical Corp.
Wallace & Tiernan Inc.

Gages, Sand Expansion

Bailey Meter Co.
Minneapolis-Honeywell Regulator Co.

Gas Holders

Bethlehem Steel Co.
Consolidated Western Steel Div.
General American Transportation Corp.
Pfaudler Permutit Inc.
Pittsburgh-Des Moines Steel Co.

Gaskets and Packing

Baker, R. H., & Co., Inc.
Continental-Fremont, Inc.
Garlock Inc.
Johns-Manville Sales Corp.
Keasbey & Mattison Co.
Reeves Rubber, Inc.

Gates, Shear and Sluice

Armco Drainage & Metal Products, Inc.
Bethlehem Steel Co.
Clow, James B., & Sons
Consolidated Western Steel Div.
Dominion Bridge Co.
Filtration Equipment Corp.
Glenfield & Kennedy Ltd.
Hunt, Rodney, Machine Co.
Hydraflo, Inc.
Iowa Valve Co.
Michigan Hydrant & Valve Mfg. Co.
Mueller Co.
Olympic Foundry Co.
Vogt Mfg. Co.

Gears, Speed-Reducing

Bethlehem Steel Co.
Philadelphia Gear Corp.
Westinghouse Electric Corp.

Geiger Counters; *see* Radiation Detectors

Generators, Electric

Allis-Chalmers Mfg. Co.
General Electric Co.
Homelite Div., Textron Inc.
Westinghouse Electric Corp.
Worthington Corp.

Glass Standards, Colorimetric

Hellige, Inc.
Wallace & Tiernan Inc.

Goosenecks

Hays Mfg. Co.
McDonald, A. Y., Mfg. Co.
Mueller Co.
Red Hed Mfg. Co.
Welsbach Corp., The

Gratings, Metal

Buffalo Pipe & Foundry Corp.
Continental-Fremont, Inc.
Dominion Bridge Co.
Olympic Foundry Co.

Gravel; *see* Filter Media

Greensand; *see* Ion-Exchange Materials

Hose, Suction and Discharge

Carter, Ralph B., Co.
Homelite Div., Textron Inc.

Hydrants, Fire

American Foundry & Mfg. Co.
Clow, James B., & Sons
Darling Valve & Mfg. Co.
East Jordan Iron Works, Inc.
Eddy Valve Co.
Glenfield & Kennedy Ltd.
Greenberg's, M., Sons
Iowa Valve Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co., Inc.
M & H Valve & Fittings Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Pacific States Cast Iron Pipe Co.
Rich Mfg. Co. of California
Rohan Co.
Smith, A. P., Mfg. Co., The
Traverse City Iron Works
Vogt Mfg. Co.
Waterous Co.
Wood, R. D., Co.

Hydrants, Sprinkling and Flushing

American Foundry & Mfg. Co.
Darling Valve & Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Mueller Co.

Hydrogen Ion Equipment

Bird-Archer Co., Ltd., The
Bristol Co., The
Dorr-Oliver Inc.
Hach Co.
Hungerford & Terry, Inc.
Infilco, Inc.
LaMotte Chemical Products Co.
Minneapolis-Honeywell Regulator Co.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Wallace & Tiernan Inc.

Hypochlorite; *see* Calcium Hypochlorite; Sodium Hypochlorite

Inhibitors

Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Dow Chemical Co., The
Nalco Chemical Co.
Owens-Corning Fiberglas Corp.
Thompson-Hayward Chemical Co.

Inserting Machines, Valve and Fitting

Milwaukee Lead Works
Mueller Co.
Smith, A. P., Mfg. Co., The
Welsbach Corp., The

Instruments, Indicating and Recording

Automatic Control Co.
B-I-F Industries, Inc.
Bailey Meter Co.
Brainard, F. S., & Co.
Bristol Co., The
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
General Electric Co.
Graver Water Conditioning Co.
Hach Co.
Hellige, Inc.
Infilco, Inc.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Rockwell Mfg. Co.
Wallace & Tiernan Inc.
Westinghouse Electric Corp.

Insulation

Johns-Manville Sales Corp.
National Tank Maintenance Corp.
Owens-Corning Fiberglas Corp.

Intake Screens

American Well Works
Chain Belt Co.
Dominion Bridge Co.
Glenfield & Kennedy Ltd.
Jeffrey Mfg. Co., The
Johnson, Edward E., Inc.
Link-Belt Co.

Ion-Exchange Materials

Allis-Chalmers Mfg. Co.
Bird-Archer Co., The
Bird-Archer Co., Ltd., The
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Maintenance Eng. Corp.
Nalco Chemical Co.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.

Iron Removal Plants

Allis-Chalmers Mfg. Co.
American Well Works
Bacharach, E. W., Inc.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Layne-Atlantic Co.
Layne Texas Co.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.

Iron Salts

American Cyanamid Co., Industrial Chemicals Div.

(*Continued on page 160*)

WACHS POW-R-DRIVE for EASIER, TIME-SAVING VALVE OPERATION

Valve Maintenance Programs are now possible at reasonable cost with Pow-R-Drive. Also gives faster valve operation in emergencies.

Heavy Duty, Portable Pow-R-Drive is ruggedly built to stand up in the toughest field jobs. It can be used in the most inaccessible places and delivers ample power to open and close large valves with great saving of time and labor.

Reversible air or electric drive motors make short work of "Freeing-up" valves.

Other uses

- Operates pipe tappers
- Operates hand winches
- Powers a geared die head for threading or cutting
- Drills horizontal or vertical holes with an auger
- Drills anode holes and post holes
- Operates sluice gates

WACHS CHICAGO

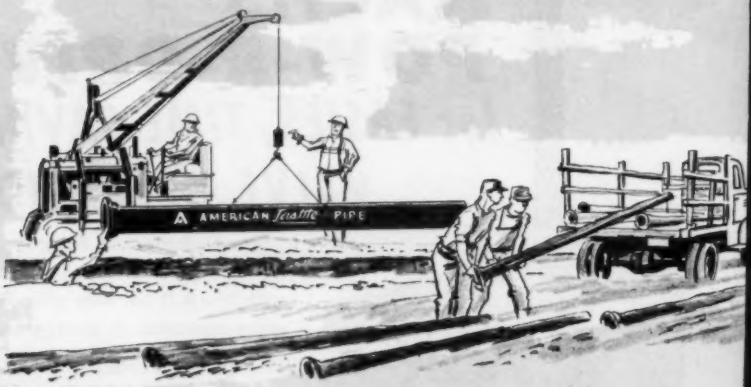
THE E. H. WACHS COMPANY

MANUFACTURERS OF PRECISION MACHINERY SINCE 1883

1525 NORTH DAYTON STREET • CHICAGO 22, ILLINOIS

PIPE

The 100 largest cities in the United States, surveyed recently, have more than 95,000 total miles of water mains — more than 90% of which is cast iron pipe!

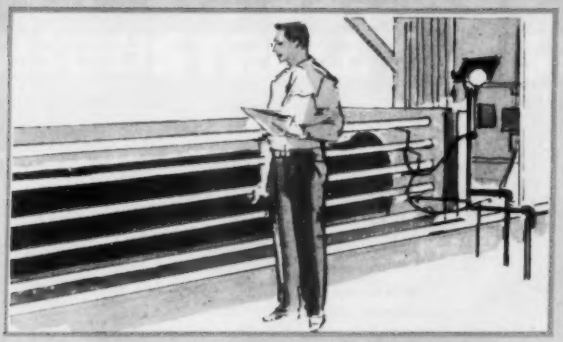


DO YOU KNOW that when larger distribution mains are needed, the smaller mains can be reclaimed for years of additional service . . . if they are cast iron? In Reading, Pa., for example . . . seven miles of cast iron pipe was taken up and relaid — saving about $350,000. Rarely, if ever, is composition pipe taken up and re-used.

DO YOU KNOW that the AMERICAN Fastite Joint requires no calking? Its only joint component is a dual hardness, easily-inserted, double-sealing rubber gasket. A minimum of labor and equipment is needed to install Fastite pipe . . . and the extra minutes saved soon total up to additional dollars saved in installation costs.

*Patent applied for

FACTS



DO YOU KNOW that cast iron pipe is designed to withstand expected water hammer shocks which can burst weaker mains? In tests, it required 3,400 psi water pressure to burst 6" Class 150 AMERICAN pipe. Composition pipe of similar size and class failed at 770 psi.

DO YOU KNOW that industry requires large volumes of water... and it must be economical? For most new industrial plants, water is the most important natural resource. In the long run, cast iron pipe delivers water cheapest of all.

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM ALABAMA

(See pp. 131–46 for addresses, including branch offices and representatives)

Consolidated Chemical Industries Div.
McKesson & Robbins, Inc.
Pennsalt Chemicals Corp.
Thompson-Hayward Chemical Co.

Jointing Materials

Gowen, Howerton, Co., Inc.
Hydraulic Development Corp.
Inertol Co., Inc.

Jointing Tools

Hydraulic Development Corp.
Mueller Co.
Pollard, Joseph G., Co., Inc.

Joints, Mechanical, Pipe

Alabama Pipe Co.
American Cast Iron Pipe Co.
Baker, R. H., & Co., Inc.
Carson, H. Y., Co.
Central Foundry Co., The
Clow, James B., & Sons
Consolidated Western Steel Div.
Dominion Bridge Co.
Dresser Mfg. Div.
Garlock Inc.
Hydraulic Supply Mfg. Co.
McWane Cast Iron Pipe Co.
Michigan Hydrant & Valve Mfg. Co.
Multiplex Mfg. Co.
Olympic Foundry Co.
Smith-Blair, Inc.
Tyler Pipe & Foundry Co.
US Pipe & Foundry Co.
Wood, R. D., Co.

Laboratory Apparatus

Hellige, Inc.
Millipore Filter Corp.

Leak Detectors

Brainard, F. S., & Co.
Fisher Research Lab., Inc.
Michigan Hydrant & Valve Mfg. Co.
Pollard, Joseph G., Co., Inc.
Robinson Pipe Cleaning Corp.
Wallace & Tiernan Inc.

Lime (Calcium Oxide)

Cutler-Magner Co.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Mississippi Lime Co.
Pelican State Lime Corp.
Southern Cement Co.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.
US Lime Products Div.

Lime, Hydrated (Calcium Hydroxide)

Cutler-Magner Co.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Mississippi Lime Co.
Pelican State Lime Corp.
Southern Cement Co.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.
US Lime Products Div.

Lime Slakers and Feeders

Allis-Chalmers Mfg. Co.
B-I-F Industries, Inc.
Infilco, Inc.
Layne & Bowler, Inc.
Pfaudler Permutit Inc.
Wallace & Tiernan Inc.

Lining; *see* Coating and Lining

Locators, Pipe and Valve Box

Fisher Research Lab., Inc.
Michigan Hydrant & Valve Mfg. Co.
Pollard, Joseph G., Co., Inc.
Robinson Pipe Cleaning Co.

Magazines; *see* Publications

Magnesium Anodes

Electro Rust-Proofing Corp.
Wallace & Tiernan Inc.

Mains; *see* Pipe

Manometers

B-I-F Industries, Inc.
Fischer & Porter Co.
General Controls Co.
Infilco, Inc.
Michigan Hydrant & Valve Mfg. Co.
Pfaudler Permutit Inc.
Wallace & Tiernan Inc.

Membrane Filter Holders

Millipore Filter Corp.

Membrane Filters

Millipore Filter Corp.

Meter Boxes

Alabama Pipe Co.
American Foundry & Mfg. Co.
Bingham & Taylor Corp.
Brooks Products, Inc.
Buffalo Pipe & Foundry Corp.
Christy Concrete Products, Inc., Forni Div.
Concrete Products & Roofing Co.
Ford Meter Box Co., The
Fraser Cement Products Co.
Michigan Hydrant & Valve Mfg. Co.
Mueller Co.
Olympic Foundry Co.
Rohan Co.
Taylor Foundry Co.
Trinity Valley Iron & Steel Co.
Tyler Pipe & Foundry Co.

Meter Couplings and Yokes

Badger Meter Mfg. Co.
Baker, R. H., & Co., Inc.
Farnan Brass Works Co., The
Ford Meter Box Co., The
Hays Mfg. Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Olympic Foundry Co.
Pubco Bronze Div., California Brass Mfg. Co.
Red Hed Mfg. Co.
Rockwell Mfg. Co.
Rohan Co.
Smith-Blair, Inc.

Meter Parts

Badger Meter Mfg. Co.
Buffalo Meter Co., Inc.
Fog-Tite Meter Seal Co.
Gamon Meter Div., Worthington Corp.
Hersey-Sparling Meter Co.
Michigan Hydrant & Valve Mfg. Co.
Neptune Meter Co.
Plumb, D. S., Co., Inc.
Rockwell Mfg. Co.
Thomson Meter Co.
Visi-Meter, Inc.

Meter Reading and Record Books

Badger Meter Mfg. Co.
Gamon Meter Div., Worthington Corp.
Pollard, Joseph G., Co., Inc.

Meter Testers

Badger Meter Mfg. Co.
Brainard, F. S., & Co.
Ford Meter Box Co., The
Hersey-Sparling Meter Co.
Michigan Hydrant & Valve Mfg. Co.
Neptune Meter Co.

Meters; *see also* Gages

Meters, Water, Compound

B-I-F Industries, Inc.
Badger Meter Mfg. Co.
Gamon Meter Div., Worthington Corp.
Hersey-Sparling Meter Co.
Maintenance Eng. Corp.
Michigan Hydrant & Valve Mfg. Co.
Neptune Meter Co.
Rockwell Mfg. Co.
Rohan Co., Inc., The

Meters, Water, Current

Badger Meter Mfg. Co.
Gamon Meter Div., Worthington Corp.
Hersey-Sparling Meter Co.
Neptune Meter Co.
Potter Aeronautical Corp.
Rockwell Mfg. Co.
Rohan Co., Inc., The

Meters, Water, Displacement

Badger Meter Mfg. Co.
Buffalo Meter Co., Inc.
Calmet Meter Div., Worthington Corp.
Gamon Meter Div., Worthington Corp.
Glenfield & Kennedy Ltd.
Hersey-Sparling Meter Co.
Michigan Hydrant & Valve Mfg. Co.
Neptune Meter Co.
Rockwell Mfg. Co.
Rohan Co.
Thomson Meter Co.

Meters, Water, Fire Service

Hersey-Sparling Meter Co.
Michigan Hydrant & Valve Mfg. Co.
Neptune Meter Co.
Rockwell Mfg. Co.

Meters, Water, Flow Tube

B-I-F Industries, Inc.
Badger Meter Mfg. Co.
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
Hersey-Sparling Meter Co.
Michigan Hydrant & Valve Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Wallace & Tiernan Inc.

Meters, Water, Recording

B-I-F Industries, Inc.
Badger Meter Mfg. Co.
Bailey Meter Co.
Brainard, F. S., & Co.
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Fischer & Porter Co.

(Continued on page 162)

NEW BULLETINS ON TREATMENT OF WATER, SEWAGE & INDUSTRIAL WASTE

AERATORS

FILTER PLANTS

CLARIFIERS

ZEOLITE SOFTENERS

AERATORS—Describes aerators for oxidation of dissolved iron and manganese, and for elimination of odors and gases. Explains and pictures forced draft aerators, pressure aerators and atmospheric aerators.

FILTER PLANTS—Lists problems of untreated water and offers solutions. Explains and pictures four basic water treatment methods for elimination of turbidity, minerals, gases, organic matter, and for pH correction.

CONTRAFLO UPFLOW CLARIFIERS—Pictures and describes five basic contraflo types for water softening and clarification. Explains application for industrial waste neutralization and recovery processes.

"CR" ZEOLITE SOFTENERS—Illustrates design and construction details of ion-exchange softeners for hardness removal; tells how to select proper units. Explains various types of regeneration equipment.

GENERAL FILTER co.

WATER PROCESS EQUIPMENT BOX 350, AMES, IOWA

W5

GENERAL FILTER CO.
P.O. Box 350, Ames, Iowa

Please send free bulletins on items checked.

Your name_____

Associated with_____

Street address _____

City _____ State _____

- ☐ Aerators
- ☐ Filter Plants
- ☐ Contraflow Upflow Clarifiers
- ☐ "CR" Zeolite Softeners
- ☐ Have representative call

(*See pp. 131–46 for addresses, including branch offices and representatives*)

Foxboro Co., The
Glenfield & Kennedy Ltd.
Infilco, Inc.
Michigan Hydrant & Valve Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Neptune Meter Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Potter Aeronautical Corp.

Meters, Water, Venturi

B-I-F Industries, Inc.
Bailey Meter Co.
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
Glenfield & Kennedy Ltd.
Infilco, Inc.
Michigan Hydrant & Valve Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.

Mixing Equipment

American Well Works
Carter, Ralph B., Co.
Dorr-Oliver Inc.
General American Transportation Corp.
General Filter Co.
Infilco, Inc.
Jeffrey Mfg. Co., The
Leopold, F. B., Co., Inc.
Philadelphia Gear Corp.
Stuart Corp.
Walker Process Equipment, Inc.

Molecular Filters; *see* Membrane Filters

Motors, Electric

Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
General Controls Co.
General Electric Co.
Layne Texas Co.
Westinghouse Electric Corp.
Worthington Corp.

Packing; *see* Gaskets and Packing

Paints

Continental-Fremont, Inc.
Gregg Co., Inc., The
Industrial Paint Co.
Inertol Co., Inc.
Koppers Co., Inc.
Rust-Oleum Corp.

Pavement Breakers

East Jordan Iron Works, Inc.
Homelite Div., Textron, Inc.

pH Analysis; *see* Hydrogen Ion Equipment

Phosphates and Polyphosphates

Allied Chemical Corp., General Chemical Div.
Bird-Archer Co., Ltd., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Consolidated Chemical Industries Div.
Hooker Chemical Corp.
LaMotte Chemical Products Co.
Maintenance Eng. Corp.
McKesson & Robbins, Inc.
Nalco Chemical Co.
Olin Mathieson Chemical Corp.
Thompson-Hayward Chemical Co.

Pipe, Asbestos-Cement

Johns-Manville Sales Corp.
Keasbey & Mattison Co.
Michigan Hydrant & Valve Mfg. Co.
Pontex Pipe Corp.
Republic Supply Co. of California, The
Rohan Co.

Pipe, Brass

Anaconda American Brass Co.
Crane Co.

Pipe, Cast-Iron

Alabama Pipe Co.
American Cast Iron Pipe Co.
Central Foundry Co., The
Clow, James B., & Sons
Glamorgan Pipe & Foundry Co.
Griffin Pipe Div.
Lone Star Steel Co.
Lynchburg Foundry Co.
McWane Cast Iron Pipe Co.
Michigan Hydrant & Valve Mfg. Co.
Pacific States Cast Iron Pipe Co.
Pontex Pipe Corp.
Tyler Pipe & Foundry Co.
US Pipe & Foundry Co.
Warren Foundry & Pipe Div. of Shahmoon Industries
Wood, R. D., Co.

Pipe, Concrete (Nonpressure)

American Pipe & Construction Co.
Concrete Conduit Co.
Gifford-Hill-American, Inc.
Lock Joint Pipe Co.
Price Brothers Co.
United Concrete Pipe Corp.

Pipe, Concrete (Pressure)

American Pipe & Construction Co.
Concrete Conduit Co.
Gifford-Hill-American, Inc.
Lock Joint Pipe Co.
Pontex Pipe Corp.
Price Brothers Co.
Southern Pipe Div., U. S. Industries Inc.
United Concrete Pipe Corp.

Pipe, Copper

Anaconda American Brass Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Red Hed Mfg. Co.
Rohan Co.

Pipe, Ductile Iron

American Cast Iron Pipe Co.
Clow, James B., & Sons
Glamorgan Pipe & Foundry Co.
McWane Cast Iron Pipe Co.

Pipe, Lead and Lead-Lined

Rohan Co.

Pipe, Plastic

Crane Co.
General American Transportation Corp.
Glamorgan Pipe & Foundry Co.
Goodall Rubber Co.
Johns-Manville Sales Corp.
Keasbey & Mattison Co.
National Tube Div., US Steel Corp.
Owens-Corning Fiberglas Corp.
Pontex Pipe Corp.
Rohan Co.
Steel & Tank Service Co.

Pipe, Steel

American Pipe & Construction Co.
Armco Drainage & Metal Products, Inc.
Babcock & Wilcox Co., The
Beall Pipe & Tank Corp.
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Consolidated Western Steel Div.
Continental-Fremont, Inc.
Crane Co.
Darby Products of Steel Plate Corp., The
Dominion Bridge Co.
Graver Tank & Mfg. Co.
Hydraulic Supply Mfg. Co.
Kaiser Steel Corp., Fabricating Div.
Lone Star Steel Co.
National Tube Div., US Steel Corp.
Nooter Corp.
Pontex Pipe Corp.
Rohan Co.
Smith-Scott Co., Inc.
Southern Pipe Div., U. S. Industries Inc.
Taylor Forge & Pipe Works
United Concrete Pipe Corp.

Pipe, Wrought-Iron

Crane Co.
Hydraulic Supply Mfg. Co.

Pipe Cleaning Services

Ace Pipe Cleaning, Inc.
Centriline Corp.
Dow Chemical Co., The
National Power Rodding Corp.
National Tank Maintenance Corp.
National Water Main Cleaning Co.
Pipe Linings Div. of American Pipe & Construction Co.
Robinson Pipe Cleaning Corp.
United Concrete Pipe Corp.

Pipe Cleaning Tools and Equipment

Allied Chemical Corp., Plastics & Coal Chemicals Div.
Flexible Inc.
Glenfield & Kennedy Ltd.
National Water Main Cleaning Co.
Smith-Scott Co., Inc.

Pipe Coating and Lining; *see* Coating and Lining

Pipe Cutting Machines

Ellis & Ford Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Pilot Mfg. Co.
Pollard, Joseph G., Co., Inc.
Wachs, E. H., Co.
Wheeler Mfg. Corp.

Pipe Fittings, Distribution

Alabama Pipe Co.
American Cast Iron Pipe Co.
Babcock & Wilcox Co., The
Baker, R. H., & Co., Inc.
Beall Pipe & Tank Corp.
Clow, James B., & Sons
Crane Co.
Dresser Mfg. Div.
East Jordan Iron Works, Inc.
Glamorgan Pipe & Foundry Co.
Griffin Pipe Div.
Hays Mfg. Co.
Independent Fitting Co., The
Johns-Manville Sales Corp.
McWane Cast Iron Pipe Co.
Milwaukee Lead Works
Olympic Foundry Co.

(*Continued on page 164*)

AMERICAN
"DRY TOP"
COMPRESSION FIRE HYDRANTS

Manufactured to Comply with
American Water Works Association Specifications

OUTSTANDING FEATURES

- **DRY TOP DESIGN**
- **THREE VALVE OPENING SIZES**
  4¼ 4½ and 5¼-inch
- **DOUBLE O-RING SEAL**
  For easier and more efficient operation
- **TWO-PIECE STANDPIPE**
  Regular or Traffic models
  (Shear bolts or breakable clamp)
- **INLET STYLE**
  For any type of pipe
- **ALL BRONZE WORKING PARTS**
  Can be withdrawn and replaced through top of hydrant without disturbing standpipe
- **AUTOMATIC DRAIN VALVE**
  Standpipe drainage assured when main valve is closed

For Literature—Write, wire or 'phone

American Foundry & Mfg. Co.
ST. LOUIS, MO.

920 Palm St. TEL CEntral 1-6114 St. Louis 7, Mo.

(See pp. 131–46 for addresses, including branch offices and representatives)

Pubco Bronze Div., California Brass Mfg. Co.
Reliable Iron Foundry, Inc.
Rohan Co.
Smith-Blair, Inc.
Smith-Scott Co., Inc.
Taylor Forge & Pipe Works
Traverse City Iron Works
Trinity Valley Iron & Steel Co.
Tyler Pipe & Foundry Co.
US Pipe & Foundry Co.
Warren Foundry & Pipe Div. of Shahmoon Industries
Wood, R. D., Co.

Pipe Fittings, Service

Adams Pipe Repair Products
Babcock & Wilcox Co., The
Baker, R. H., & Co., Inc.
Dresser Mfg. Div.
Fairbanks Co., The
Ford Meter Box Co., The
Griffin Pipe Div.
Hays Mfg. Co.
Independent Fitting Co., The
Johns-Manville Sales Corp.
Mueller Co.
Olympic Foundry Co.
Pubco Bronze Div., California Brass Mfg. Co.
Red Hed Mfg. Co.
Rohan Co., Inc., The
Smith-Blair, Inc.
Taylor Foundry Co.
Trinity Valley Iron & Steel Co.
Welsbach Corp., The

Pipe Jointing Materials; *see* Jointing Materials

Pipe Joints, Mechanical; *see* Joints, Mechanical

Pipe Locators; *see* Locators

Pitot Recorders

Bailey Meter Co.
Foxboro Co., The
Minneapolis-Honeywell Regulator Co.
Pfaudler Permutit Inc.

Polyelectrolytes (Coagulant Aids)

American Cyanamid Co., Industrial Chemicals Div.
Bird-Archer Co., Ltd., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Dow Chemical Co., The
Nalco Chemical Co.

Potassium Permanganate

Allied Chemical Corp., General Chemical Div.
Carus Chemical Co., Inc.
McKesson & Robbins, Inc.
Thompson-Hayward Chemical Co.

Pressure Regulators; *see* Controllers

Primers, Pump

Michigan Hydrant & Valve Mfg. Co.

Protective Coating; *see* Coating and Lining

Publications

American City Magazine
Engineering News-Record
Municipal South
Public Works
Water & Sewage Works
Water Works Engineering
Western City

Pumps, Boiler Feed

Allis-Chalmers Mfg. Co.
Byron Jackson Pumps, Inc.
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
De Laval Steam Turbine Co.
Fairbanks, Morse & Co.
Jacuzzi Bros. Inc.
Johnston Pump Co.
Layne & Bowler, Inc.
Peerless Pump Div., Food Machinery & Chemical Corp.
Wheeler, C. H., Mfg. Co.
Worthington Corp.

Pumps, Centrifugal

Allis-Chalmers Mfg. Co.
American Well Works
Byron Jackson Pumps, Inc.
Carter, Ralph B., Co.
Chain Belt Co.
Chicago Pump Co.
De Laval Steam Turbine Co.
Dorr-Oliver Inc.
Fairbanks, Morse & Co.
Homelite Div., Textron, Inc.
Jacuzzi Bros. Inc.
Layne & Bowler, Inc.
Layne Texas Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Peerless Pump Div., Food Machinery & Chemical Corp.
Texas Water Wells, Inc.
Wheeler, C. H., Mfg. Co.
Worthington Corp.

Pumps, Chemical Feed

American Well Works
B-I-F Industries, Inc.
Bird-Archer Co., Ltd., The
Byron Jackson Pumps, Inc.
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Dorr-Oliver Inc.
Fischer & Porter Co.
Jacuzzi Bros. Inc.
Maintenance Eng. Corp.
Wallace & Tiernan Inc.
Wheeler, C. H., Mfg. Co.

Pumps, Deep Well

American Well Works
Byron Jackson Pumps, Inc.
Fairbanks, Morse & Co.
Jacuzzi Bros. Inc.
Johnston Pump Co.
Layne & Bowler, Inc.
Layne Texas Co.
McDonald, A. Y., Mfg. Co.
Peerless Pump Div., Food Machinery & Chemical Corp.
Rinbrand Well Drilling Co., Inc.
Sumo Pumps, Inc.
Texas Water Wells, Inc.
Worthington Corp.

Pumps, Diaphragm

B-I-F Industries, Inc.
Carter, Ralph B., Co.
Chain Belt Co.
Dorr-Oliver Inc.
Fairbanks, Morse & Co.
Fischer & Porter Co.
Homelite Div., Textron, Inc.
Michigan Hydrant & Valve Mfg. Co.
Sparkler Mfg. Co.
Wallace & Tiernan Inc.

Pumps, Hydrant

Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Pollard, Joseph G., Co., Inc.

Pumps, Hydraulic Booster

Byron Jackson Pumps, Inc.
De Laval Steam Turbine Co.
Fairbanks, Morse & Co.
Johnston Pump Co.
Layne & Bowler, Inc.
Sumo Pumps, Inc.

Pumps, Plunger Sludge

Carter, Ralph B., Co.
Chicago Pump Co.
Dorr-Oliver Inc.
Michigan Hydrant & Valve Mfg. Co.

Pumps, Portabl

Carter, Ralph B., Co.
Chain Belt Co.
Fairbanks, Morse & Co.
Homelite Div., Textron, Inc.
Jacuzzi Bros. Inc.
Michigan Hydrant & Valve Mfg. Co.
Peerless Pump Div., Food Machinery & Chemical Corp.

Pumps, Sewage

Allis-Chalmers Mfg. Co.
American Well Works
Chicago Pump Co.
Dorr-Oliver Inc.
Fairbanks, Morse & Co.
Johnston Pump Co.
Michigan Hydrant & Valve Mfg. Co.
Peerless Pump Div., Food Machinery & Chemical Corp.
Wheeler, C. H., Mfg. Co.
Worthington Corp.

Pumps, Submersible

Byron Jackson Pumps, Inc.
Chicago Pump Co.
Fairbanks, Morse & Co.
Jacuzzi Bros. Inc.
Johnston Pump Co.
Layne & Bowler, Inc.
Layne-Atlantic Co.
Layne Texas Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Peerless Pump Div., Food Machinery & Chemical Corp.
Sumo Pumps, Inc.
Texas Water Wells, Inc.
Westinghouse Electric Corp.
Worthington Corp.

Pumps, Sump

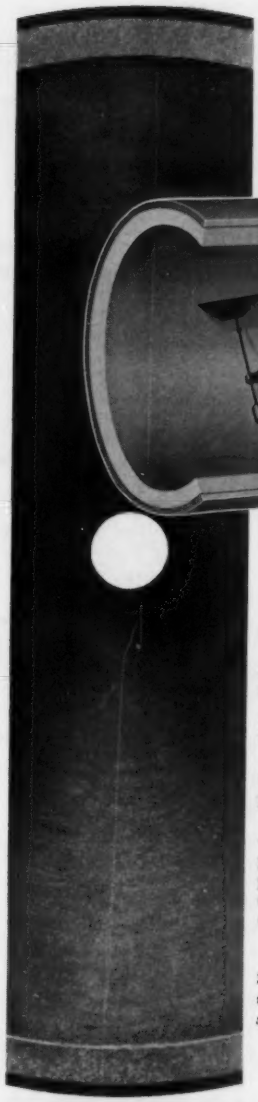
Allis-Chalmers Mfg. Co.
Byron Jackson Pumps, Inc.
Chicago Pump Co.
Fairbanks, Morse & Co.
Jacuzzi Bros. Inc.
Johnston Pump Co.
Layne & Bowler, Inc.
Layne-Atlantic Co.
Michigan Hydrant & Valve Mfg. Co.
Peerless Pump Div., Food Machinery & Chemical Corp.
Sumo Pumps, Inc.
Wheeler, C. H., Mfg. Co.

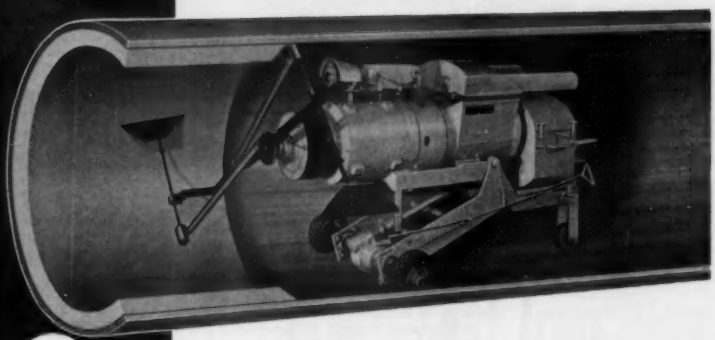
Pumps, Turbine

Allis-Chalmers Mfg. Co.
American Well Works
Byron Jackson Pumps, Inc.
Fairbanks, Morse & Co.
Jacuzzi Bros. Inc.
Johnston Pump Co.

(*Continued on page 166*)

A TOOL FOR RESTORING FLOW





SPUNLINE®

increases carrying capacity

SAN FRANCISCO BOOSTS MGD OF BAY PIPELINE

To meet increased demands for water, the City of San Francisco cleaned and cement mortar lined Bay Division Pipeline No. 1. The new carrying capacity of this pipeline approaches a 25 per cent increase.

The Spunline process provides a smooth surface for maximum carrying capacity, eliminates further corrosive buildup and seals leaks. The pipeline will again do the job for which it was designed.

The Spunline process centrifugally applies a continuous coating of dense cement mortar to the interior of the pipe. Further corrosion is prevented, flow is restored and leaks are sealed. All work is accomplished in place without interrupting normal traffic. Spunline is applied to pipe lines from 4" to 180" and may be used in cast iron, steel, wrought iron and concrete pipe lines.

Send for bulletin with detailed data and specifications.

PIPE LININGS Inc.

Subsidiary of American Pipe and Construction Co.

2414 East 223rd Street, Wilmington, California
P.O. Box 457 • Phones: SPruce 5-3273 - TErminal 5-8201
50 Church Street, New York 7, N.Y. • P.O. Box 1202, Fort Worth, Texas

SPUNLINE®

(See pp. 131–46 for addresses, including branch offices and representatives)

Layne & Bowler, Inc.
Layne-Atlantic Co.
Layne Texas Co.
Peerless Pump Div., Food Machinery & Chemical Corp.
Rinbrand Well Drilling Co., Inc.
Texas Water Wells, Inc.
Worthington Corp.

Radiation Detectors
Westinghouse Electric Corp.

Radio Equipment, Mobile
General Electric Co.

Recarbonators; *see* Carbon Dioxide Generators

Recording Instruments; *see* Instruments, Indicating & Recording

Regulators; *see* Controllers

Reservoirs; *see* Tanks

Rust Prevention
American Pipe & Construction Co.
Bease-Johnson Co.
Bird-Archer Co., Ltd., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Continental-Fremont, Inc.
Dow Chemical Co., The
Electro Rust-Proofing Corp.
Industrial Paint Co.
Inertol Co., Inc.
Koppers Co., Inc.
McCrea Corrosion Engineering Co.
Nalco Chemical Co.
National Tank Maintenance Corp.
Owens-Corning Fiberglas Corp.
Pfaudler Permutit Inc.
Pittsburgh Chemical Co.
Rust-Oleum Corp.
Wallace & Tiernan Inc.

Saddles, Service
Baker, R. H., & Co., Inc.
Milwaukee Lead Works
Mueller Co.
Olympic Foundry Co.
Pubco Bronze Div., California Brass Mfg. Co.
Smith-Blair, Inc.

Salt; *see* Sodium Chloride

Sampling Apparatus (Water)
Leopold, F. B., Co., Inc.

Sand; *see* Filter Media

Sand Expansion Gages; *see* Gages

Sand Washers and Separators
Consolidated Western Steel Div.
Dorr-Oliver Inc.
Equipment Engineers, Inc.
Glenfield & Kennedy Ltd.

Screens; *see* Intake Screens; Well Screens

Sedimentation Equipment
American Well Works
Chain Belt Co.
Dorr-Oliver Inc.
General Filter Co.
Graver Water Conditioning Co.
Infilco, Inc.
Jeffrey Mfg. Co., The
Link-Belt Co.
Michigan Hydrant & Valve Mfg. Co.
Walker Process Equipment, Inc.

Service Boxes; *see* Curb Boxes; Meter Boxes

Sleeves
Baker, R. H., & Co., Inc.
Clow, James B., & Sons
Dresser Mfg. Div.
East Jordan Iron Works, Inc.
M & H Valve & Fittings Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Olympic Foundry Co.
Rohan Co., Inc., The
Smith, A. P., Mfg. Co., The
Smith-Blair, Inc.
Traverse City Iron Works
Trinity Valley Iron & Steel Co.
Tyler Pipe & Foundry Co.
US Pipe & Foundry Co.
Vogt Mfg. Co.
Wood, R. D., Co.

Sleeves and Valves, Tapping
Clow, James B., & Sons
Darling Valve & Mfg. Co.
Dresser Mfg. Div.
East Jordan Iron Works, Inc.
Eddy Valve Co.
Iowa Valve Co.
M & H Valve & Fittings Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Olympic Foundry Co.
Rich Mfg. Co. of California
Rohan Co.
Smith, A. P., Mfg. Co., The
Smith-Blair, Inc.
Traverse City Iron Works
Vogt Mfg. Co.

Sludge Blanket Equipment
Dorr-Oliver Inc.
General Filter Co.
Infilco, Inc.
Pfaudler Permutit Inc.

Soda Ash (Sodium Carbonate)
Consolidated Chemical Industries Div.
Diamond Alkali Co.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Pittsburgh Plate Glass Co., Chemical Div.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Sodium Aluminate
Gowen, Howerton, Co., Inc.
Nalco Chemical Co.
Thompson-Hayward Chemical Co.

Sodium Chloride
Cutler-Magner Co.
International Salt Co., Inc.
Jones Chemicals, Inc.
Morton Salt Co.
Pittsburgh Plate Glass Co., Chemical Div.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Sodium Chlorite
Jones Chemicals, Inc.
Olin Mathieson Chemical Corp.
Thompson-Hayward Chemical Co.

Sodium Fluoride and Silicofluoride; *see* Fluoride

Sodium Hexametaphosphate
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Gowen, Howerton, Co., Inc.
Hooker Chemical Corp.
Jones Chemicals, Inc.
Maintenance Eng. Corp.
McKesson & Robbins, Inc.
Nalco Chemical Co.
Olin Mathieson Chemical Corp.
Pfaudler Permutit, Inc.
Thompson-Hayward Chemical Co.

Sodium Hydroxide; *see* Caustic Soda

Sodium Hypochlorite
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Pennsalt of Washington Div., Pennsalt Chemicals Corp.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Sodium Pyrosulfite
Allied Chemical Corp., General Chemical Div.
McKesson & Robbins, Inc.

Sodium Silicate
Allied Chemical Corp., General Chemical Div.
Diamond Alkali Co.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Thompson-Hayward Chemical Co.

Softener Service, Domestic
Pfaudler Permutit Inc.

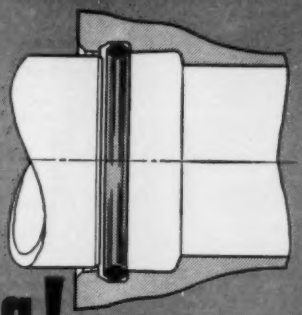
Softeners, Ion-Exchange
Allis-Chalmers Mfg. Co.
Bird-Archer Co., Ltd., The
Calgon Co., Div. of Hagan Chemicals & Controls, Inc.
Cochrane Div., Crane Co.
Dorr-Oliver Inc.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Layne & Bowler, Inc.
Layne Texas Co.
Maintenance Eng. Corp.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.

Softeners, Lime-Soda
Allis-Chalmers Mfg. Co.
Cochrane Div., Crane Co.
General Filter Co.
Graver Water Conditioning Co.
Infilco, Inc.
Jeffrey Mfg. Co., The
Layne & Bowler, Inc.
Layne Texas Co.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.

Softening Chemicals
Bird-Archer Co., Ltd., The
Gowen, Howerton, Co., Inc.
International Salt Co., Inc.
Layne & Bowler, Inc.
Nalco Chemical Co.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.

(*Continued on page 168*)

so simple in design...
so easy to assemble...



it can't be installed wrong!

APCO Super-DeLavaud Cast Iron Pipe

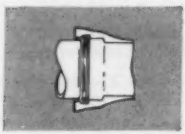
with the famous

ALTITE JOINT

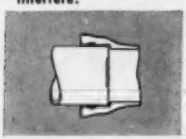
Underwriters Approved — Protected by Patent

Insert rubber gasket in bell end of pipe. You can't put it in wrong.

Lubricate lightly to reduce friction.



Insert plain beveled end — there are no grooves, ridges, or tips on gasket to interfere.



Small amount of pressure forces end to bottom of socket, completing the tight joint.

Requires only one accessory — a reversible rubber gasket as shown above. Assembly is quickly made — even by inexperienced crews.

Inside contour of the bell provides seat for holding the gasket firmly in place. Plain end of pipe is furnished with a bevel to aid in sliding into gasket.

Underwriters Laboratory approved, the APCO ALTITE JOINT is the answer to savings in installation costs...and savings in time.

Write for your copy of Catalog No. 54

ALABAMA PIPE COMPANY
A Division of Woodward Iron Company
ANNISTON, ALABAMA • Phone ADams 6-7601

5335 Southern Ave., South Gate, Calif.
CHICAGO: 122 S. Michigan Ave. KANSAS CITY: Suite 950, 1006 Grand Ave.
NEW YORK: 350 Fifth Avenue DETROIT: 18505 W. Eight Mile Road

(See pp. 131–46 for addresses, including branch offices and representatives)

Solids-Contact Units
Cochrane Div., Crane Co.
General Filter Co.
Infilco, Inc.
Pfaudler Permutit Inc.

Stacks
American Pipe & Construction Co.
Beall Pipe & Tank Corp.
Bease-Johnson Co.
Bethlehem Steel Co.
Caldwell, W. E., Co.
Chicago Bridge & Iron Co.
Consolidated Western Steel Div.
Continental-Fremont, Inc.
Darby Products of Steel Plate Corp., The
Dominion Bridge Co.
General American Transportation Corp.
Graver Tank & Mfg. Co.
Hydraulic Supply Mfg. Co.
National Tank Maintenance Corp.
Nooter Corp.
Pittsburgh-Des Moines Steel Co.
Steel & Tank Service Co.

Standpipes; *see* Tanks

Steel Plate Construction
American Pipe & Construction Co.
Beall Pipe & Tank Corp.
Bering Co., The, Tank Div.
Bethlehem Steel Co.
Caldwell, W. E., Co.
Chicago Bridge & Iron Co.
Consolidated Western Steel Div.
Continental-Fremont, Inc.
Darby Products of Steel Plate Corp., The
Dominion Bridge Co.
Fisher Tank Co.
General American Transportation Corp.
Graver Tank & Mfg. Co.
Hydraulic Supply Mfg. Co.
National Tank Maintenance Corp.
Nooter Corp.
Pittsburgh-Des Moines Steel Co.
United Concrete Pipe Corp.
Universal Construction Co.

Storage Tanks; *see* Tanks

Strainers, Suction
American Foundry & Mfg. Co.
Bethlehem Steel Co.
Johnson, Edward E., Inc.
Layne & Bowler, Inc.

Sulfur Dioxide
McKesson & Robbins, Inc.
Thompson-Hayward Chemical Co.

Sulfuric Acid
Allied Chemical Corp., General Chemical Div.
American Cyanamid Co., Industrial Chemicals Div.
Consolidated Chemical Industries Div.
Gowen, Howerton, Co., Inc.
Jones Chemicals, Inc.
McKesson & Robbins, Inc.
Olin Mathieson Chemical Corp.
Pennsalt Chemicals Corp.
Thompson-Hayward Chemical Co.

Surface Wash Equipment
Filtration Equipment Corp.
Leopold, F. B., Co., Inc.
Maintenance Eng. Corp.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Stuart Corp.

Swimming Pool Equipment
B-I-F Industries, Inc.
Baker, R. H., & Co., Inc.
Cla-Val Co.
Fairbanks, Morse & Co.
Fischer & Porter Co.
General Filter Co.
Gunite Assocs., Inc.
Hellige, Inc.
Hungerford & Terry, Inc.
Inertol Co., Inc.
Infilco, Inc.
Jacuzzi Bros. Inc.
LaMotte Chemical Products Co.
Layne & Bowler, Inc.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Sparkler Mfg. Co.
Wallace & Tiernan Inc.

Tanks, Prestressed Concrete
Gunite Assocs., Inc.
Preload Co., Inc., The

Tanks, Steel
American Pipe & Construction Co.
Beall Pipe & Tank Corp.
Bering Co., The, Tank Div.
Bethlehem Steel Co.
Caldwell, W. E., Co.
Chicago Bridge & Iron Co.
Cochrane Div., Crane Co.
Consolidated Western Steel Div.
Continental-Fremont, Inc.
Darby Products of Steel Plate Corp., The
Dominion Bridge Co.
Fisher Tank Co.
General American Transportation Corp.
Graver Tank & Mfg. Co.
Hydraulic Supply Mfg. Co.
Kessler, K., Co., The
National Tank Maintenance Corp.
Nooter Corp.
Pittsburgh-Des Moines Steel Co.
Sparkler Mfg. Co.
United Concrete Pipe Corp.
Universal Construction Co.
Water Tank Service Co.
Wheeler, C. H., Mfg. Co.
Whitmire Tank Co., Inc.

Tanks, Wood
Caldwell, W. E., Co.
National Tank Maintenance Corp.

Tank Painting and Repair
Bease-Johnson Co.
Caldwell, W. E., Co.
Central Steel Tank Co.
Consolidated Western Steel Div.
Continental-Fremont, Inc.
Darby Products of Steel Plate Corp., The
Dominion Bridge Co.
General American Transportation Corp.
Industrial Paint Co.
Kessler, K., Co., The
Koppers Co., Inc.
McCrea Corrosion Engineering Co.
National Tank Maintenance Corp.
Neumann Co. Contractors, Inc.
Pittman, William G., Co., Inc.
Steel & Tank Service Co.
Universal Construction Co.
Water Tank Service Co.
Watertower Paint & Repair Co., Inc.
Whitmire Tank Co., Inc.

Tapping Machines
Hays Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Red Hed Mfg. Co.
Rohan Co.
Smith, A. P., Mfg. Co., The
Welsbach Corp., The

Taste and Odor Removal Chemicals
Carus Chemical Co., Inc.
Industrial Chemical Sales Div., West Virginia Pulp & Paper Co.
McKesson & Robbins, Inc.
Nalco Chemical Co.
Olin Mathieson Chemical Corp.
Pfaudler Permutit Inc.
Tesco Chemicals, Inc.
Thompson-Hayward Chemical Co.

Taste and Odor Removal Plants
American Well Works
Cochrane Div., Crane Co.
General Filter Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Layne & Bowler, Inc.
Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Sparkler Mfg. Co.
Walker Process Equipment, Inc.
Wallace & Tiernan Inc.

Telemetering Equipment
Automatic Control Co.
B-I-F Industries, Inc.
Bristol Co., The
Buffalo Meter Co., Inc.
Central Telemetering & Control
Fischer & Porter Co.
Foxboro Co., The
General Controls Co.
General Electric Co.
Hammarlund Automation Div.
Healy-Ruff Co.
Michigan Hydrant & Valve Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Penn Instruments Div., Burgess-Manning Co.
Pfaudler Permutit Inc.
Radio Frequency Labs., Inc.
Westinghouse Electric Corp.

Testing Apparatus; *see* Water Testing

Tools and Hardware
Mueller Co.
Pilot Mfg. Co.
Rohan Co.

Trade Associations
American Concrete Pressure Pipe Assn.
Cast Iron Pipe Research Assn.
Copper & Brass Research Assn.
Lead Industries Assn.
Steel Plate Fabricators Assn.

Treads, Metal
Dominion Bridge Co.

Treatment Plants
American Well Works
Chicago Pump Co.
Continental-Fremont, Inc.
General Filter Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Jeffrey Mfg. Co., The
Kaiser Engrs.
Layne & Bowler, Inc.
Layne Texas Co.
Municipal Service Co.

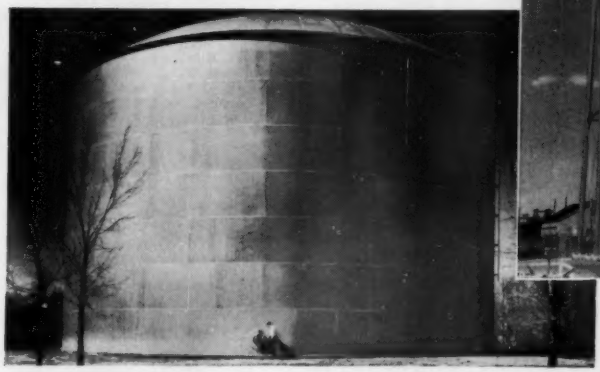
(Continued on page 170)

WATER STORAGE TANKS
all types . . . all sizes

NOOTER ST. LOUIS

- OVER HALF A CENTURY EXPERIENCE IN TANK FABRICATION OF ALL KINDS
- SHOP FABRICATED AND FIELD ERECTED

ELEVATED WATER TANK
200,000 gallon capacity.



GROUND LEVEL RESERVOIR
2,500,000 gallon capacity.

with EVERY NOOTER TANK
you benefit from:

- Deliveries You Can Depend On. Work scheduling is an important aspect of Nooter fabrication . . . dependable delivery dates are a basic policy with Nooter.
- Competitive Prices. Solid prices backed up by sound money-saving techniques, resulting from 59 years of tank-fabrication.
- Outstanding Appearance. Nooter design and construction places a high value on attractive appearance.

Write for recommendations and quotations . . . no obligation.

STANDPIPE
290,000 gallon capacity.

NOOTER
CORPORATION

1415 SOUTH THIRD STREET, ST. LOUIS 66, MISSOURI

(See pp. 131–46 for addresses, including branch offices and representatives)

Pfaudler Permutit Inc.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.

Tubing; *see* Pipe

Turbidimetric Apparatus (For Turbidity and Sulfate Determinations)
Hach Co.
Hellige, Inc.
Minneapolis-Honeywell Regulator Co.

Turbines, Hydraulic
Allis-Chalmers Mfg. Co.
Willamette Iron & Steel Co.

Turbines, Steam
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.
Westinghouse Electric Corp.
Worthington Corp.

Unaccounted-for Water; *see* Leak Detectors; Waste Detection

Valve Boxes; *see* Curb Boxes; Meter Boxes

Valve Inserting Machines; *see* Inserting Machines

Valve Operating Units
B-I-F Industries, Inc.
Darling Valve & Mfg. Co.
General Controls Co.
Hupp Aviation Co.
Infilco, Inc.
Philadelphia Gear Corp.
Pratt, Henry, Co.
Wachs, E. H., Co.
Wheeler, C. H., Mfg. Co.

Valves, Air Relief
Cla-Val Co.
Cochrane Div., Crane Co.
Crane Co.
Darling Valve & Mfg. Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Ludlow Valve Mfg. Co., Inc., The
Michigan Hydrant & Valve Mfg. Co.
Mueller Co.
Multiplex Mfg. Co.
Olympic Foundry Co.
Pfaudler Permutit Inc.
Rohan Co.

Valves, Altitude
Allis-Chalmers Mfg. Co.
B-I-F Industries, Inc.
Cla-Val Co.
DeZurik Corp.
General Controls Co.
Golden-Anderson Valve Specialty Co., Inc.
Michigan Hydrant & Valve Mfg. Co.
Pratt, Henry, Co.
Ross Valve Mfg. Co.
Willamette Iron & Steel Co.

Valves, Backflow Prevention
Backflow Eng. & Equipment Co.
Cla-Val Co.
Crane Co.
DeZurik Corp.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Michigan Hydrant & Valve Mfg. Co.
Ross Valve Mfg. Co.

Valves, Ball
Allis-Chalmers Mfg. Co.
Fairbanks Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Michigan Hydrant & Valve Mfg. Co.
Multiplex Mfg. Co.
Pratt, Henry, Co.
Willamette Iron & Steel Co.

Valves, Butterfly
Allis-Chalmers Mfg. Co.
B-I-F Industries, Inc.
Consolidated Western Steel Div.
Darling Valve & Mfg. Co.
Foxboro Co., The
General Controls Co.
Glenfield & Kennedy Ltd.
Leopold, F. B., Co., Inc.
Michigan Hydrant & Valve Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Pratt, Henry, Co.
Rockwell, W. S., Co.

Valves, Check
Allis-Chalmers Mfg. Co.
Cla-Val Co.
Clow, James B., & Sons
Cochrane Div., Crane Co.
Combination Pump Valve Co.
Crane Co.
Darling Valve & Mfg. Co.
East Jordan Iron Works, Inc.
Eddy Valve Co.
Fairbanks Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Iowa Valve Co.
Kennedy Valve Mfg. Co., The
Ludlow Valve Mfg. Co., Inc., The
M & H Valve & Fittings Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Pratt, Henry, Co.
Rich Mfg. Co. of California
Rockwell, W. S., Co.
Rockwell Mfg. Co.
Rohan Co.
Smith, A. P., Mfg. Co., The
Traverse City Iron Works
Willamette Iron & Steel Co.

Valves, Compression
Ford Meter Box Co., The
General Controls Co.
McDonald, A. Y., Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Pubco Bronze Div., California Brass Mfg. Co.
Red Hed Mfg. Co.
Rohan Co.

Valves, Cone
Allis-Chalmers Mfg. Co.
DeZurik Corp.
Fairbanks Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Michigan Hydrant & Valve Mfg. Co.
Olympic Foundry Co.
Pratt, Henry, Co.
Pubco Bronze Div., California Brass Mfg. Co.
Rockwell Mfg. Co.
Willamette Iron & Steel Co.

Valves, Detector Check
Michigan Hydrant & Valve Mfg. Co.

Valves, Electrically Operated
Allis-Chalmers Mfg. Co.
B-I-F Industries, Inc.
Cla-Val Co.
Clow, James B., & Sons
Crane Co.
Darling Valve & Mfg. Co.
DeZurik Corp.
Eddy Valve Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Hupp Aviation Co.
Iowa Valve Co.
Ludlow Valve Mfg. Co., Inc., The
M & H Valve & Fittings Co.
Michigan Hydrant & Valve Mfg. Co.
Pratt, Henry, Co.
Rockwell, W. S., Co.
Rockwell Mfg. Co.
Smith, A. P., Mfg. Co., The
Willamette Iron & Steel Co.

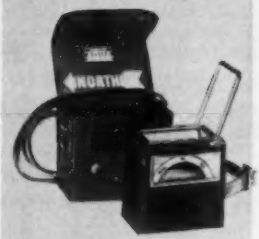
Valves, Flap
Clow, James B., & Sons
East Jordan Iron Works, Inc.
Eddy Valve Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Hunt, Rodney, Machine Co.
Hydraflo, Inc.
Iowa Valve Co.
M & H Valve & Fittings Co.
Michigan Hydrant & Valve Mfg. Co.
Mueller Co.
Olympic Foundry Co.
Traverse City Iron Works
Vogt Mfg. Co.

Valves, Float
Allis-Chalmers Mfg. Co.
Cla-Val Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Multiplex Mfg. Co.
Pratt, Henry, Co.
Rockwell, W. S., Co.
Ross Valve Mfg. Co.

Valves, Foot
Clow, James B., & Sons
Cochrane Div., Crane Co.
Crane Co.
Eddy Valve Co.
General Controls Co.
Glenfield & Kennedy Ltd.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.

Valves, Gate
American Foundry & Mfg. Co.
American Well Works
Clow, James B., & Sons
Consolidated Western Steel Div.
Crane Co.

(Continued on page 172)



"Only The Best"

For ordering dependable and proven pipe line equipment, consult your latest Pollard Catalog #27.

Included in the #27 Catalog, and displayed on this page, are the M-Scope Transistorized Combination Leak Detector and Pipe Locator, Audio-Scope, Geophone Leak Detectors, T-10 Electronic Box Locator, Aqua Valve Box Locator and Magnetic Dipping Needles for locating service boxes.

Hundreds of water departments all over the country are using Pollard "one order" service. You, too, can enjoy the advantages of ordering from the nation's #1 source for dependable pipe line equipment.

PIPE LINE EQUIPMENT
JOSEPH G. POLLARD CO., INC.
PIPE LINE EQUIPMENT
PIPE LINE EQUIPMENT

Place your next order with POLLARD

It's from POLLARD . . . It's the Best in Pipe Line Equipment

NEW HYDE PARK • NEW YORK

Branch Offices: 964 Peoples Gas Building, Chicago, Illinois
323 Candler Building, Atlanta, Georgia

PHONE: PIONEER 6-0842

(*See pp. 131–46 for addresses, including branch offices and representatives*)

Darling Valve & Mfg. Co.
DeZurik Corp.
East Jordan Iron Works, Inc.
Eddy Valve Co.
Fairbanks Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Iowa Valve Co.
Kennedy Valve Mfg. Co., The
Ludlow Valve Mfg. Co., Inc., The
M & H Valve & Fittings Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Pacific States Cast Iron Pipe Co.
Rich Mfg. Co. of California
Rohan Co., Inc., The
Smith, A. P., Mfg. Co., The
Traverse City Iron Works
Vogt Mfg. Co.
Wood, R. D., Co.

Valves, Hose

Clow, James B., & Sons
Crane Co.
Darling Valve & Mfg. Co.
Fairbanks Co.
Kennedy Valve Mfg. Co., The
Ludlow Valve Mfg. Co., Inc., The
Michigan Hydrant & Valve Mfg. Co.
Pubco Bronze Div., California Brass Mfg. Co.
Rohan Co.
Traverse City Iron Works

Valves, Hydraulically Operated

Allis-Chalmers Mfg. Co.
B-I-F Industries, Inc.
Cla-Val Co.
Clow, James B., & Sons
Consolidated Western Steel Div.
Crane Co.
Darling Valve & Mfg. Co.
DeZurik Corp.
Eddy Valve Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Iowa Valve Co.
Ludlow Valve Mfg. Co., Inc., The
M & H Valve & Fittings Co.
Michigan Hydrant & Valve Mfg. Co.
Pratt, Henry, Co.
Rockwell, W. S., Co.
Rockwell Mfg. Co.
Rohan Co.
Smith, A. P., Mfg. Co., The
Traverse City Iron Works
Vogt Mfg. Co.
Willamette Iron & Steel Co.

Valves, Mud

Clow, James B., & Sons
General Controls Co.
Hunt, Rodney, Machine Co.
Iowa Valve Co.
M & H Valve & Fittings Co.
Michigan Hydrant & Valve Mfg. Co.
Mueller Co.
Olympic Foundry Co.
Roberts Filter Mfg. Co.
Traverse City Iron Works
Vogt Mfg. Co.

Valves, Plug; *see* Valves, Cone

Valves, Swing Check

Cla-Val Co.
Clow, James B., & Sons
Crane Co.
Darling Valve & Mfg. Co.
East Jordan Iron Works, Inc.
Fairbanks Co.
General Controls Co.
Glenfield & Kennedy Ltd.
Golden-Anderson Valve Specialty Co., Inc.
Iowa Valve Co.
Kennedy Valve Mfg. Co., The
Ludlow Valve Mfg. Co., Inc., The
M & H Valve & Fittings Co.
McDonald, A. Y., Mfg. Co.
Michigan Hydrant & Valve Mfg. Co.
Milwaukee Lead Works
Mueller Co.
Rockwell, W. S., Co.
Rohan Co.
Smith, A. P., Mfg. Co., The
Traverse City Iron Works

Valves, Uniflow Check

General Controls Co.

Valves, Wye

Cla-Val Co.
General Controls Co.
Rockwell, W. S., Co.

Venturi Tubes; *see* Meters

Waste Detection

Brainard, F. S., & Co.
Pitometer Assocs., Inc.

Water Testing Apparatus

Bird-Archer Co., The
Bird-Archer Co., Ltd., The
Fischer & Porter Co.
Graver Water Conditioning Co.
Hach Co.
Hellige, Inc.
Hungerford & Terry, Inc.
LaMotte Chemical Products Co.
Layne & Bowler, Inc.
Millipore Filter Corp.
Nalco Chemical Co.
Pfaudler Permutit Inc.
Wallace & Tiernan Inc.

Waterproofing

Globe Linings, Inc.
Gowen, Howerton, Co., Inc.
Gulf-Seal Corp.
Inertol Co., Inc.
National Tank Maintenance Corp.

Weed Killer, Aquatic

Allied Chemical Corp., General Chemical Div.
Diamond Alkali Co.
Jones Chemicals, Inc.
Nalco Chemical Co.
Thompson-Hayward Chemical Co.

Well Casings

American Cast Iron Pipe Co.
Armco Drainage & Metal Products, Inc.
Consolidated Western Steel Div.
Johnson, Edward E., Inc.
Kaiser Steel Corp., Fabricating Div.
Layne & Bowler, Inc.
Layne Texas Co.
Taylor Forge & Pipe Works

Well Drillers; *see* Contractors

Well Reconditioning & Formation Testing

Dow Chemical Co., The
Halliburton Co.
Johnson, Edward E., Inc.
Layne & Bowler, Inc.
Layne-Atlantic Co.
Layne Texas Co.
Ohio Drilling Co.
Texas Water Wells, Inc.

Well Screens

Johnson, Edward E., Inc.
Layne & Bowler, Inc.
Layne-Atlantic Co.
Layne Texas Co.
Ohio Drilling Co.
Texas Water Wells, Inc.

Well Strainers

Johnson, Edward E., Inc.
Layne & Bowler, Inc.
Layne-Atlantic Co.
Layne Texas Co.

Wood Tanks; *see* Tanks

Wrenches; *see* Tools & Hardware

Zeolite; *see* Ion-Exchange Materials; Softeners

DISTRIBUTORS

Chemical Feed Equipment

LeValley McLeod, Inc.
Sherman Machine & Iron Works

Chemicals

American Oil & Supply Co.
Halliburton Co.
LeValley McLeod, Inc.
McKesson & Robbins, Inc.
Millipore Filter Corp.
Phipps & Bird, Inc.
Thompson-Hayward Chemical Co.
Water Works Supply Co.

Control Equipment

LeValley McLeod, Inc.
Sherman Machine & Iron Works

Laboratory Supplies

Millipore Filter Corp.
Phipps & Bird, Inc.

Machinery and Motors

Howard Supply Co.
LeValley McLeod, Inc.

Meters and Gages

LeValley McLeod, Inc.
Olsen, E. C., Co.
Pensinger's
Sherman Machine & Iron Works
Valley Cities Supply Co.

Pipe and Fittings

Crane Co.
Ellis & Ford Mfg. Co.
Howard Supply Co.

(*Continued on page 174*)

WHY USE TWICE THE WATER YOU NEED TO CLEAN FILTER BEDS?

H & T AIR-WATER WASH FILTERS use only half as much water as ordinary systems. Yet the air and water, together, clean the filter bed more completely!

We are the ONLY large, experienced manufacturer of Air-Water Wash Filters. In the past 45 years, we've made hundreds of successful installations. Get the money-saving facts about H & T AIR-WATER WASH FILTERS.

SEND FOR BULLETIN 23-B

H&T SERVICE

HUNGERFORD & TERRY, INC.

Clayton 5, New Jersey

AWWA Manual Series

Your library should contain these three useful guides, each dealing comprehensively with an important aspect of water utility practice. Published in handy 6 × 9-inch format, attractively bound in distinctive, stiff-paper covers.

M2—PUBLIC RELATIONS Practical, "how to do it" information on effective talks, personnel relations, school programs, publicity, advertising, and plant beautification. With an appendix of facts and ideas for water works speakers. 152 pp. **Price, $1.50.**

M5—MANAGEMENT A chapter apiece on each of 22 key topics with which everyone in utility management should be familiar, including such essentials as rates and regulations, legal responsibility, and office operation. Indexed. 192 pp. **Price, $2.00**; to members or schools *ordering quantities of 20 or more,* $1.30 per copy.

M6—METERS Vital information on the selection, installation, testing, and maintenance of meters. Generously illustrated, complete with tables of data, and indexed for ready reference. Prepared by the AWWA Committee on Water Meters. 88 pp. **Price, $1.25.**

American Water Works Assn., 2 Park Ave., New York 16, N.Y.

(See pp. 131–46 for addresses, including branch offices and representatives)

Kelly Pipe Co.
LeValley McLeod, Inc.
Olsen, E. C., Co.
Pacific Southwest Pipe Co.
Pensinger's
Republic Supply Co. of California
Sherman Machine & Iron Works
Valley Cities Supply Co.
Water Works Supply Co.

Pipelaying and Jointing Materials

Ellis & Ford Mfg. Co.
LeValley McLeod, Inc.
Pensinger's
Sherman Machine & Iron Works
Valley Cities Supply Co.
Water Works Supply Co.

Pumps

Crane Co.
Howard Supply Co.
LeValley McLeod, Inc.
Olsen, E. C., Co.
Phipps & Bird, Inc.
Rinbrand Well Drilling Co., Inc.
Sherman Machine & Iron Works
Water Works Supply Co.

Tools and Hardware

Ellis & Ford Mfg. Co.
Howard Supply Co.
LeValley McLeod, Inc.
Republic Supply Co. of California
Valley Cities Supply Co.
Water Works Supply Co.

Valves and Hydrants

American Foundry & Mfg. Co.
Crane Co.
Ellis & Ford Mfg. Co.
Howard Supply Co.
LeValley McLeod, Inc.
Olsen, E. C., Co.
Pacific Southwest Pipe Co.
Pensinger's
Republic Supply Co. of California
Sherman Machine & Iron Works
Valley Cities Supply Co.
Water Works Supply Co.

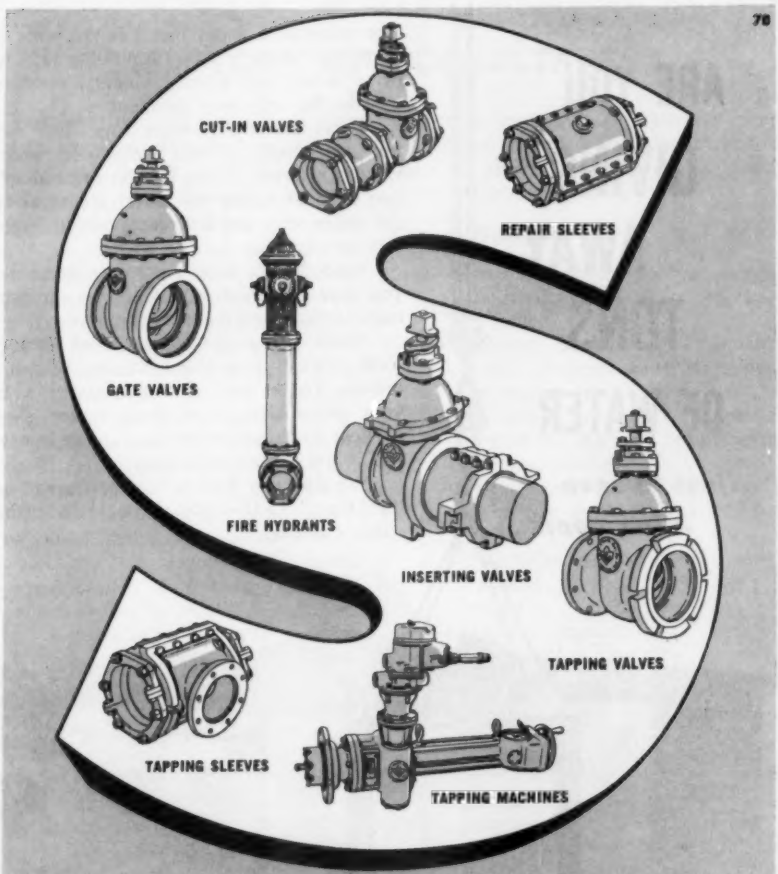
Well Systems and Equipment

Layne-Atlantic Co.
LeValley McLeod, Inc.
Olsen, E. C., Co.
Sherman Machine & Iron Works
Water Works Supply Co.

LIST OF ADVERTISERS

Advertising space in the Directory is made available only to individuals and firms holding membership in AWWA

Alabama Pipe Co. 167
Allied Chemical Corp., General Chemical Div. 127
American Cast Iron Pipe Co. 158, 159
American Cyanamid Co., Process Chemicals Dept. 102
American Foundry & Mfg. Co. 163
American Pipe & Construction Co. 109
Armco Drainage & Metals Products, Inc., 187
Badger Meter Mfg. Co. 193
B-I-F Industries, Inc. 103
Cast Iron Pipe Research Assn., The . 100, 101
Centriline Corp. 139
Charles Machine Co. 112
Chicago Bridge & Iron Co. 194
DeZurik Corp. 110
Dominion Bridge Co. Ltd. 181
Dorr-Oliver Inc. ..... Cover 3
Electro Rust-Proofing Corp. 115
Fischer & Porter Co. 111
Fisher Tank Co. 145
Ford Meter Box Co., The 128
Gamon Meter Div., Worthington Corp. .. 99
General American Transportation Corp. .. 185
General Chemical Div., Allied Chemical Corp. 127
General Filter Co. 161
Golden-Anderson Valve Specialty Co. 116
Graver Tank & Mfg. Co. 129, 130
Halliburton Co. 155
Hays Mfg. Co. 151
Hersey-Sparling Meter Co. 105, 153
Hungerford & Terry, Inc. 173
Industrial Chemical Sales Div., West Virginia Pulp & Paper Co. 98
Inertol Co., Inc. 118
Infilco Inc. 135
Johns-Manville Corp. 148
K. Kessler Co., Inc., The 124
Koppers Co., Inc. 104
LaMotte Chemical Products Co. 122
Layne & Bowler, Inc. 123
Leopold, F. B., Co. 107
Lock Joint Pipe Co. 97
Lone Star Steel Co. 117
M & H Valve & Fittings Co. 108
Mueller Co. 147
National Tank Maintenance Corp. 119
National Water Main Cleaning Co. 189
Neptune Meter Co. 176
Neumann Co. 179
Nooter Corp. 169
Northern Gravel Co. 191
Peerless Pump Div. 183
Permutit Co. 120, 121
Pilot Mfg. Co. 191
Pipe Linings, Inc. 165
Pittsburgh-Des Moines Steel Co. 113
Pittsburgh Equitable Meter Div. (Rockwell Mfg. Co.) 133
Pollard, Jos. G., Co., Inc. 171
Preload Co., Inc. 137
Professional Services 82
Rockwell Mfg. Co. 133
Ross Valve Mfg. Co. 126
Smith, A. P., Mfg. Co., The 175
Southern Pipe Div. of U.S. Industries .. 141
Tank Painting and Repairing Services ... 94
U.S. Pipe & Foundry Co. 125
Wachs, E. H., Co. 157
Wallace & Tiernan Inc. 106
Wheeler Mfg. Corp. 114
Wood, R. D. Co. ..... Cover 2
Worthington Corp. 143



The A. P. Smith Manufacturing Company has served the water and gas utility industry for over 60 years; supplying them with a broad line of superior products including Gate Valves, Fire Hydrants, Tapping Sleeves and Valves and allied equipment.

Smith also designs and builds products for highly specialized services and operating conditions. We solicit your inquiries for standard and special design products.

HYDRANTS — VALVES

THE A. P. SMITH MFG. CO.

— SINCE 1896 —

EAST ORANGE NEW JERSEY

ARE YOU GIVING AWAY TONS OF WATER

...just to save a few cents

The value of a water meter is not what it costs, but what it *earns*. Actually, its "bid price" is only your down payment, and could well be the only *easy* payment.

There are two reasons. First, like any fine instrument, a water meter loses accuracy as it wears. If you buy on price alone, you may soon find the meter giving away far more than the few cents you thought you saved.

Secondly, to keep the meter accurate, you may have high repair costs... or premature scrap-and-replace programs.

Water is your city's most vital service. You entrust it to the accuracy of your meters. To be sure of this accuracy, visit your meter shop. Ask which meter gives highest sustained revenue... with lowest repair and depreciation costs.

We sincerely believe the answer will be "Trident." 15,000,000 since 1898... the world's leader.

NEPTUNE METER COMPANY
LIQUID METER DIVISION
47-25 34th St., Long Island City 1, N. Y.
Neptune Meters, Ltd., 1430 Lakeshore Rd., Toronto 14, Ont. / Offices in Principal Cities

DIRECTORY OF CONSULTANTS

The information on consultants that appears below was compiled from questionnaires sent to all AWWA members in early 1961. The Directory includes all such members who offered consulting services in one of several branches of activity, who were not known to be connected with a firm engaged in the sale of products or services other than consultation, and who listed some clients by whom they had recently been retained. None of these references, however, has been investigated by the Association.

Individuals are cross-referenced to the firms with which they are associated, and company names are printed in boldface type. When the firm takes its name from an individual, the name appears in boldface. Listings are geographic by states. Permanent branch offices have been listed only when staffed by AWWA members.

The italic letters following the address of a firm indicate the type of work done, in accordance with the key given below. All the activities denoted by each code letter are not necessarily performed by each firm so designated, however, as it has not proved practicable to break down the listings to distinguish specialization or limited activity within the various major fields. The code should therefore be accepted with reservations, as a general guide only. Additional activities not considered to be of primary interest to those in the water supply and closely allied fields are omitted.

Key to Symbols

A—General civil engineering, design, construction, operation, or maintenance
B—Sanitary engineering, municipal and industrial water treatment, sewerage, or drainage
C—Appraisal, valuation, or inspection
D—Chemistry, chemical engineering, or bacteriology
E—Geology or ground water
F—Hydrology or resources development
G—Hydraulics, distribution system studies
H—Irrigation
J—Electrical engineering
K—Mechanical engineering
L—Accounting, taxation, rates, financing, law
M—Corrosion, cathodic protection
N—Laboratory testing
*—Registered as a professional engineer in the state under which the listing appears
†—Diplomate in the American Academy of Sanitary Engineers

ALABAMA

Brodnax & Knight, Inc., 916 Brown-Marx Bldg., Birmingham 3 *L*

Cox, James L.; *see* Brodnax & Knight

*Gilmer, W. L.; *see* Polglaze & Basenberg

***Hendon, Harry, & Assocs., Inc.,** Box 7404A, Birmingham 13

*Jowers, A. B.; *see* Harry Hendon & Assocs.

Polglaze & Basenberg, 812 South 27th St., Birmingham 5 *ABCEFG*

Strickland & Assocs., *Raymond E. Strickland Jr., 2129—7th Ave., N., Birmingham *AJK*

ARIZONA

Anderson Engineering Corp., *Gene E. Anderson, 2549 Broadway, Tucson *ABEGH*

Blanton & Cole, 211 W. Pennington St., Tucson *ABCGJKN*

*Brereton, Robert M.; *see* John A. Carollo

*†**Carollo, John A.,** 3308 N. 3rd St., Phoenix *ABCDEGHJKLM*

*Cushing, Robert M.; *see* John A. Carollo

*Girand, John; *see* Johanessen & Girand

*Halpenny, Leonard C.; *see* Water Development Corp.

*Jackson, Leon W.; *see* John A. Carollo

Johannessen & Girand, Inc., 6601 N. Black Canyon Hwy., Phoenix 15 *ABCFGHJK*

***Munn, Harvey T.,** 2709 E. 8th St., Tucson 12 *AFGK*

*Norton, Robert L.; *see* Johannessen & Girand

*Rollins, Charles A.; *see* John A. Carollo

*Stufflebean, John H.; *see* Blanton & Cole

***Thiele, Henrich J.,** 6250 E. Monterosa Ave., Scottsdale *EF*

***Turner, Samuel F.,** 350 E. Camelback Rd., Phoenix 12 *EF*

Water Development Corp., 3938 Santa Barbara Ave., Tucson *EF*

(*Continued from page 177*)

ARKANSAS

*Hall, Lewis Watson; *see* Watson Hall

Hall, Watson, 5601 Country Club Blvd., Little Rock *ABCGL*

***Kazmann, Raphael G.,** Box 451, Stuttgart *EF*

Mayhan, W. A., 500 Fairfax Terrace, Little Rock *BDN*

*†**McGoodwin, L. M.,** 1146 Mission Blvd., Fayetteville *ABG*

***Mickle, James D.,** 2101 S. H St., Fort Smith *ABHJKN*

***Smith, Harold L.,** Box 31, Stuttgart *ABCEFGH*

***Zander, Paul M.,** 509 E. Markham St., Little Rock *ABCEFGHL*

CALIFORNIA

***Abrams, Philip,** 1478 S. Calle Rolph, Palm Springs *ABCEFGHL*

Adams, Morgan, Latham, Kripp & Wright, 3633 Long Beach Blvd., Long Beach *ABC GJK*

Alderman & Swift, Frank E. Alderman, 1520 Oxley St., South Pasadena *ABCGL*

***Arnold, William L.,** Box 316, San Gabriel *L*

*†Aultman, William W.; *see* James M. Montgomery

***Barney, William E.,** 788 E. Washington St., Pasadena *ABG*

***Blakeley, Loren E.,** 125 S. Claudina St., Anaheim *CEF*

Bradberry, Carroll E., & Assocs., Box 936, Los Altos *ABEFGHM*

*Brelje, Walter E.; *see* Sarles, Brelje & Race

Brown & Caldwell, 66 Mint St., San Francisco *BN*

Carter, Ralf C.; *see* Engineering-Science

***Clark, Everett L.,** 215 W. 7th St., Los Angeles 14 *ACEFGHL*

***Cunningham, John A.,** 3565 Ross St., Riverside *L*

Daniel, Mann, Johnson & Mendenhall, 3325 Wilshire Blvd., Los Angeles 5 *ABEFGHJK*

*DeArmond, Gene V.; *see* Dean S. Kingman

***Dobrin, Saxe,** 1945 Teresita Lane, Newport Beach *F*

***Drake, Charles W.,** 3788 McCray St., Riverside *CFGHL*

***Dunn, William G., Eng. Office of,** 1535 Castilleja Ave., Palo Alto *AEFGHL*

Engineering-Science, Inc., 150 E. Foothill Blvd., Arcadia *AFCDEFGMN*

*Florer, Robert S.; *see* Lawrence, Fogg, Florer & Smith

Gillett-Harris & Assocs., Donald H. Gillett, Box 308, Yuba City *AB*

Golden & Bryant, *Joseph F. Golden, Box 1329, El Centro *ABCEFGHJKL*

*Graham, E. H., Jr.; *see* Koebig & Koebig

*Hall, D. M.; *see* Koebig & Koebig

*Haver, Charles J.; *see* Quinton Engrs.

*Heidrick, Harold H.; *see* Wilsey, Ham & Blair

***Hinckley, Horace P.,** 101 E. Olive Ave., Redlands *CFGH*

Holladay & Westcott, 800 W. Colorado Blvd., Los Angeles 41 *BDKM*

***Holman, H. C.,** 234 W. Harding Way, Stockton 4 *ABG*

***Hostrup, C. F., & Assocs.,** 1510 Westwood Blvd., Los Angeles 24 *ABFG*

*†**Ingram, William T.,** 90 Panoramic Way, Walnut Creek *B*

***Jacob, C. E.,** Box 347, Northridge *BEFH*

*Jeffreys, C. E. P.; *see* Truesdail Labs.

*†**Jenks, Harry N.,** 545 Byron St., Palo Alto *B*

Kaiser Engrs., 300 Lakeside Dr., Oakland *ABEFGHJK*

***Keeling, Harry J.,** 1780 S. Robertson Blvd., Los Angeles *CJKM*

***Kennedy, Robert C.,** 2615 Haverhill Dr., Oakland 11 *ABGH*

*†Kennedy, Robert M.; *see* Kennedy Engrs.

Kennedy Engrs., 604 Mission St., San Francisco *ABCDEFGHJKLMN*

Kingman, Dean S., 1907 University Ave., Palo Alto *BCEG*

Koebig & Koebig, Inc., 3242 W. 8th St., Los Angeles 5 *ABCEFGHJK*

*†Lawrance, C. H.; *see* Koebig & Koebig

Lawrence, Fogg, Florer & Smith, 4769 Spring St., La Mesa *ABFG*

*†**Layton, R. E. & Assocs.,** 655 W. Ave. 135th, San Leandro *ABEFGHJK*

Lieberman, Morton W., 11 Belvedere Ave., Belvedere *BF*

*Lonner, Harry W.; *see* Quinton Engrs.

*Lovelace, Milton Albert; *see* Harold S. Prescott

*†Ludwig, Harvey F.; *see* Engineering-Science

*Lundin, R. P.; *see* Koebig & Koebig

Mann, John F., Jr., 945 Reposado Dr., La Habra *EF*

***Mau, Carl F.,** 19990 Bella Vista Ave., Saratoga *ACL*

McCandless & Jett, *†Charles S. McCandless, Box 845, Menlo Park *BEGH*

*†**McKee, Jack Edward,** 2026 Oakdale St., Pasadena *BDEFG*

*Miller, David R.; *see* Daniel, Mann, Johnson & Mendenhall

Montgomery, James M., Inc., 535 E. Walnut St., Pasadena *BC*

*Morgan, Charles P.; *see* Adams, Morgan, Latham, Kripp & Wright

***Morris, Samuel B.,** 3716 Amesbury Rd., Los Angeles 27 *EF*

*Neill, Clayton B., Jr.; *see* Neill Engrs.

Nelli Engrs., *Clayton B. Neill, Box LL, Carmel *BCDEGJ*

*Nevin, Robert L.; *see* Carroll E. Bradberry & Assocs.

***O'Connell, William J., & Assocs.,** 1214 Burlingame Ave., Burlingame *BCDFGLM*

*Orlob, Gerald T.; *see* Water Resources Engrs.

***Pearson, Erman A.,** 3372 McGraw Lane, Lafayette *B*

Pomeroy & Assocs., *Richard Pomeroy, 660 S. Fair Oaks Ave., Pasadena *BD*

Prescott, Harold S., Box 42, Loomis *AB*

Quinton Engrs., Ltd., 812 W. 8th St., Los Angeles *ABGJK*

*†**Ramseier, Roy Edwin, & Assocs.,** 1539 Solano Ave., Berkeley 7 *BEFGMN*

Sanford, J. Homer, 1601 Camulos Ave., Glendale *EF*

Sarles, Brelje & Race, *Frank B. Sarles, 425 South E St., Santa Rosa *ABFGH*

Schiff, M. J., 283 E. Benwood St., Covina *M*

*Shaffer, R. W.; *see* Wilsey, Ham & Blair

*Shelton, M. J.; *see* Koebig & Koebig

*Spencer, R. D.; *see* Koebig & Koebig

*†Stauff, John H.; *see* M. Carleton Yoder

*†**Stone, Ralph,** 147 San Vicente Blvd., Beverly Hills *ABCDEFGHLMN*

*Swift, Frank M.; *see* Alderman & Swift

*Theroux, R. J.; *see* Koebig & Koebig

Truesdail Labs., Inc., 4101 N. Figueroa St., Los Angeles 65 *D*

***VandenBossche, H. C.,** 1125 W. 6th St., Los Angeles *AB*

Water Resources Engrs., Inc., 2054 University Ave., Berkeley *BEFGH*

Webb, Albert A., Assocs., 3788 McCray St., Riverside

*Westcott, Ralph M.; *see* Holladay & Westcott

Wilsey, Ham & Blair, 111 Rollins Rd., Belmont *CL*

Wilson, Carl, Labs., 1107 W. 7th St., Los Angeles 17 *DN*

***Yackey, George F.,** Box 871, Fallbrook *AFGHK*

***Yackey, Harold H.,** 1261 Airborne Dr., Vista *ABCFGK*

*†**Yoder, M. Carleton,** 2054 University Ave., Berkeley 4 *BG*

Zupnick, Lillian; *see* Carl Wilson Labs.

COLORADO

***Boyce, Robert Q.,** 9400 W. 26th Ave., Denver *ABG*

***Elliot, Simon F.,** 111 E. 5th St., Pueblo *AB*

***Hopper, C. H. & Co.,** 818 7th St., Denver 2 *ABCEJL*

*McGillis, James D.; *see* Ken R. White

Nelson, Haley, Patterson & Quirk, 911 16th St., Greeley *ABCGKM*

(*Continued on page 180*)

TANK PAINTING

by Neumann Co.

Timely Repainting Saves Costly Repairing. When Did You Last Inspect YOUR Tank? Tank Protection and Beauty with Paint Jobs by the NEUMANN COMPANY

THREE 500,000 GALLON MODERN, STREAMLINE WATER SPHEROIDS DESIGNED AND BUILT BY CHICAGO BRIDGE AND IRON COMPANY PAINTED BY NEUMANN COMPANY

The Green Legs of This Tank Make it Hardly Noticeable to Residents of Grand Rapids Area

Landmark of Streator, Illinois Painted by Neumann Company

Tank at Coldwater, Michigan After Receiving New Paint Job by Neumann Company

For Information and Quotations Write or Call

HUdson 3-2852

NEUMANN COMPANY

CONTRACTORS

INDUSTRIAL PAINTING—DECORATING—SPRAYING—SAND BLASTING
POWER CLEANING—WATERPROOFING—TOWER LETTERING

946 W. 69th ST. CHICAGO 21, ILL.

Member of American Water Works Association

(*Continued from page 178*)

Parker & Assocs., *W. F. Parker Jr., 1714—9th St., Greeley *ABG*

*Patterson, William D.; *see* Nelson, Haley, Patterson & Quirk

Ripple & Howe, Inc., 2747 Zuni St., Denver 11 *ABCFGKLN*

***Ryan, A. J., & Assocs.**, 1340 Glenarm Pl., Denver 4 *ABCFGH*

*†Vaseen, V. A.; *see* Ripple & Howe

Walker, Theodore R., Dept. of Geology, Univ. of Colorado, Boulder *E*

***White, Ken R., Inc.**, 1567 Marion St., Denver *ABCEFGHJK*

CONNECTICUT

*Newell, I. Laird; *see* Henry Souther Eng. Co.

Souther, Henry, Eng. Co., 11 Laurel St., Hartford *ABCDMN*

*†**Tarlton, Ellis A.**, 34 Pleasant St., Danbury *ABCDEFGN*

DISTRICT OF COLUMBIA

Ewin Eng. Assocs., 5104 MacArthur Blvd., N.W. *AB*

*Hubbard, William F.; *see* Ewin Eng. Assocs.

*Levi, Gilbert V.; *see* Resources Research

Resources Research, Inc., 1246 Taylor St., N.W. *BDEFN*

FLORIDA

Beeman, Britt, Curley & Jaffer, 3621B Henderson Blvd., Tampa 9 *ABJK*

*Bishop, William F.; *see* Mosby Eng. Assocs.

*Black, A. P.; *see* Black, Crow & Eidsness

Black, Crow & Eidsness, Inc., *Charles A. Black, 700 S.E. 3rd St., Gainesville *ABDEFGIKLMN*

Briley, Wild & Assocs., *†Harold D. Briley, Box 3052, Daytona Beach *BG*

Brockway, Weber & Brockway, Inc., Box 1891, West Palm Beach *ABEG*

*Buckley, John D.; *see* Maurice H. Connell & Assocs.

*Chastain, James Roy; *see* Lakeland Eng. Assoc.

Cohen, Stanley L., 1222 N.E. 163rd St., North Miami Beach *L*

Connell, Maurice H., & Assocs., Box 35-726 Miami *ABFGHJK*

Dayer Eng., Inc., 7630 Biscayne Blvd., Miami *ABCG*

DeWolf, A. B.; *see* Gee & Jenson

*†Eidsness, Fred A.; *see* Black, Crow & Eidsness

Flood, Wilson & Assocs., *John H. Flood, Jr., Box 5861, Jacksonville 7 *BCG*

Gee & Jenson, 117½ S. Dixie, West Palm Beach *ABCDEFGHJKL*

Gervers, James A., 3010 N.W. 36th St., Box 35, Miami *BDN*

*†Gillespie, Wylie W.; *see* Smith & Gillespie

*†Greenleaf, John W.; *see* Radar & Assocs.

*Jaffer, Robert P.; *see* Beeman, Britt, Curley & Jaffer

Lakeland Eng. Assoc., Inc., 3114 S. Florida Ave., Box 495, Lakeland *ABGHJK*

*Meyer, Mortimer; *see* Dayer Eng.

Mosby Eng. Assocs., Inc., Box 1779, Sarasota *ABFGH*

*†**O'Neall, A. E. Assocs., Inc.**, 2626 Edgewater Dr., Orlando *ABCFG*

*†**Parks, Walter J., Jr.**, 325 Main St., Jacksonville 2 *BCFGH*

Philpott, Ross & Saarinen, Inc., 1191 S.E. 17th St., Fort Lauderdale *ABCEFGJK*

Pullara & Watson, 3013 Horatio St., Tampa 9 *ABCEFGJKM*

Rader & Assocs., First National Bank Bldg., Miami 32 *ABCG*

Reynolds, Smith & Hills, Box 4817, Jacksonville 1 *ABCGH*

*†Richheimer, Charles E.; *see* Reynolds, Smith & Hills

*†Saarinen, Arthur W., Jr.; *see* Philpott, Ross & Saarinen

*†**Saville, Thorndike**, 2225 N.W. 2nd Ave., Gainesville *F*

Smally, Wellford & Malven, 133 S. McIntosh Rd., Sarasota *ABFGKN*

*†**Smith, David B.**, 716 E. University Ave., Gainesville *BEFG*

Smith & Gillespie, Box 1048, Jacksonville *ABCGJK*

***Stilley, Sidney H., & Assocs.**, 1230 Hendricks Ave., Jacksonville

*Watson, William A.; *see* Pullara & Watson

*Wellford, Marion; *see* Smally, Wellford & Malven

*†Wild, Harry E.; *see* Briley, Wild & Assocs.

GEORGIA

Dean Eng. Co., *Joel Jackson Dean, 111 N. Rosewood Dr., Albany *ABCEFGHLM*

*Kaufman, Robert C.; *see* Wiedeman & Singleton

Robert & Co., Assocs., 96 Poplar St., Atlanta *ABCG*

Sewell & Assocs., Inc., *Dan E. Sewell, 13 York St. E., Savannah *ABCEFG*

Wiedeman & Singleton, 760 W. Peachtree St., N.W., Atlanta 8 *ABG*

Zimmerman, Evans & Leopold, *H. F. Zimmerman, Daniel Field, Augusta *ABCDGJK*

HAWAII

Austin, Smith & Assocs., Inc., *Donald S. Austin, Suite 502, 850 Richards St., Honolulu *ABCFGH*

*†Bogost, Meyer S.; *see* L. Frederick Pack Assoc.

Pack, L. Frederick, Assoc., 931 University Ave., Honolulu 14 *ABG*

Sunn, Low, Tom & Hara, Inc., *Franklin Y. K. Sunn, 195 S. King St., Honolulu *ABCG*

IDAHO

***Briggs & Assocs.**, *Raymond J. Briggs, 619 Grove St., Boise *ABCEFGHJKL*

Butler Eng. Assocs., *T. C. Butler Jr., 3015 Apple St., Boise *ABCEFGHKM*

Cornell, Howland, Hayes & Merryfield, Idaho Bldg., Boise *ABCEFGHJKM*

Hamilton & Voeller, *R. F. Hamilton, 110 N. 2nd Ave., Pocatello *AB*

*Reynolds, Earl J.; *see* Cornell, Howland, Hayes & Merryfield

ILLINOIS

Alvord, Burdick & Howson, 20 N. Wacker Dr., Chicago 6 *BC*

*†**Anderson, Robert H.**, 16 E. Main St., St. Charles *ABCEFG*

*Aten, Richard E.; *see* Clark, Daily & Dietz

Behrman, A. S., 9 S. Clinton St., Chicago *BD*

Bleck, H. B., Eng., *John H. Bleck, 1321 Glen Rock Ave., Waukegan *ABCG*

Casler & Assocs., 202 S. Church St., Jacksonville *ABCEFG*

***Chastain, Homer L., & Assocs.**, 155½ W. Main St., Decatur *ABCEFGJK*

Clark, Daily & Dietz, 211 N. Race St., Urbana *ABCEFGL*

*Clarke, Samuel M.; *see* Greeley & Hansen

Consoer, Townsend & Assocs., 360 E. Grand Ave., Chicago 11 *ABCEGIK*

Crawford, Murphy & Tilly, *†L. K. Crawford, 755 S. Grand Ave., West Springfield *ABEFG*

*Dick, Richard I.; *see* Clark, Daily & Dietz

*†Dietz, Jess C.; *see* Clark, Daily & Dietz

Farnsworth & Wylie, *George L. Farnsworth Jr., 220 W. Jefferson St., Bloomington *ABCEFG*

***Fletcher, E. N.**, 1426 Miner St., Des Plaines *AB*

Greeley & Hansen, *†Samuel A. Greeley, 14 E. Jackson Blvd., Chicago 14 *BCEFGL*

***Greengard, Charles W., Assocs.**, 730 Waukegan Rd., Deerfield *ABG*

Guillou, John C.; *see* Hydraulic Investigations

***Hamilton, Robert E.**, 2112 W. Jefferson St., Joliet *BG*

***Hancock, Edwin, Eng. Co.**, 1509 W. Jackson Blvd., Chicago 7 *AB*

*Houser, Donald E.; *see* Casler & Assocs.

*†Howson, L. R.; *see* Alvord, Burdick & Howson

Hunt, Robert W., Co., 810 S. Clinton St., Chicago 7

Hydraulic Investigations, 2106 Grange Dr., Urbana *BFGN*

McCoy & Warren, 2 N. Broadway, Aurora *ABG*

(*Continued on page 182*)

It's hard to beat steel...

When it comes to selecting pipe for a water main it's hard to beat steel. Steel's natural strength and ductility resist damage from soil stress, surface vibration, and water shock. Welded joints stay tight and loss through seepage is eliminated. Steel is light. Long sections speed up laying and fewer joints have to be made. Installation costs are at a minimum.

Dominion Bridge make and install welded steel pipe to A.W.W.A. and other specifications. Have them quote on your needs.

74

Steel Pipe by DOMINION BRIDGE

DOMINION BRIDGE COMPANY LIMITED - FIFTEEN PLANTS COAST-TO-COAST

(*Continued from page 180*)

*Millis, John B., Suite 1657, 53 W. Jackson Blvd., Chicago 4 *E*

*†Moore, Vail H., 101 W. Ottawa Rd., Paxton *ABEFG*

Mulford Eng. Service, *James E. Mulford, 33 W. 16th St., Chicago Heights *AB*

*†Niles, Thomas N.; *see* Greeley & Hansen

Pappmeier Eng. Co., *Louis S. Pappmeier, R. R. 2, Galesburg *ABEG*

*Pfulb, Lourde C., Jr.; *see* C. K. Willett

*Pyatt, Edwin E., Dept. of Civil Eng., Northwestern Univ., Evanston *BFG*

*†Rehm, Leo F.; *see* Consoer, Townsend & Assocs.

Rettig, G. J.; *see* Alvord, Burdick & Howson

*†Riddell, Matthew D. R.; *see* Greeley & Hansen

*Swanton, John R.; *see* Consoer, Townsend & Assocs.

*Warren, Robert A.; *see* McCoy & Warren

*West, Robert H., & Assocs., 864 E. Northwest Hwy., Mount Prospect *BCFG*

Wight Engrs., *George Wight, 446 E. Main St., Barrington *ABCFG*

Willett, C. K., 317 N. Galena Ave., Dixon *ABCEFG*

INDIANA

Cecil, Carl, & Assocs., 6457 Riverview Dr., Indianapolis 20 *L*

*Cole, Charles W., & Son, 3600 E. Jefferson Blvd., South Bend 1 *AB*

Couch, L. I., Co., 1224 N. Capitol Ave., Indianapolis 2 *ABG*

Dickstein, Irwin L.; *see* Urban Testing Labs.

*Erganian, George K.; *see* Henry B. Steeg & Assocs.

Fraps, Thompson & Unversaw, *A. W. Fraps, 3763 Broadway, Indianapolis 5 *ABJK*

*Kleiser, Paul J., & Assocs., 671 Tippecanoe St., Terre Haute *ABCG*

*Maller, Ray C.; *see* L. I. Couch Co.

*Niles, Charles F.; *see* Henry B. Steeg & Assocs.

Phelps, Boyd E., Inc., 1000 Washington St., Michigan City *ABCDGJK*

*†Richetta, Joseph D.; *see* Paul J. Kleiser & Assocs.

Steeg, Henry B., & Assocs., 3338 N. Illinois St., Indianapolis *B*

Urban Testing Labs., 1601 S. Clifton, Bloomington *DMN*

*Watson, Nelson, Jr., & Assocs., C.M.R. 9, Crawfordsville *ABCGL*

*Williams, Clyde E., & Assocs., 312 W. Colfax Ave., South Bend 1 *AB*

*Wilson, J. B., & Assocs., 521 K. of P. Bldg., Indianapolis *BEG*

IOWA

*Bright, Kenneth M.; *see* Stanley Eng. Co.

*Cleasby, John L.; *see* Paul Morgan & Assoc.

Collins Eng. Co., *Eldon M. Collins, 105 Westwood Dr., Marshalltown *ABCGH*

DeWild, Grant, Reckert & Stevens, Rock Rapids *ABEGJK*

Guillaume, William F.; *see* Sherman Smith & Assocs.

Morgan, Paul, & Assoc., 1214 Curtiss, Ames *BD*

*Reckert, Robert; *see* DeWild, Grant, Reckert & Stevens

Smith, Sherman, & Assocs., *Sherman A. Smith, 921 Summer St., Burlington *ABCEGKL*

Stanley Eng. Co., Hershey Bldg., Muscatine *ABCEGJKL*

*Veenstra, H. Robert; *see* Stanley Eng. Co.

KANSAS

*Antrim, Howard C., 1313 Quindaro Blvd., Kansas City 4 *ABC*

Boyer - Sweeney - Hagadorn Engrs., 107 E. Mulberry, Salina *AB*

Ediger & Co., *O. O. Ediger, Box 4145, Wichita 2 *AB*

*Hagadorn, Lester T.; *see* Boyer-Sweeney-Hagadorn Engrs.

Hefling Eng. Co., *A. W. Hefling, Box 449, Hutchinson *AB*

*Rector, K. E., & Assocs., 701 Jackson, Topeka *ABG*

Schlup, Truman, 1401 Fairfax Traffic Way, Kansas City *AB*

Servis, Van Doren & Hazard, 2910 Topeka Blvd., Topeka *ABCEFG*

*Willey, Kenneth W.; *see* Wilson & Co.

Wilson & Co., *Murray A. Wilson, Box 28, Salina *ABCDFGJKMN*

KENTUCKY

*Bell, Grant S.; *see* Howard K. Bell

Bell, Howard K., Inc., 553 S. Limestone St., Lexington *ABCG*

*Finney, J. Wiley, Jr.; *see* Howard K. Bell

Hollis & Griggs, Inc., *Elmer Y. Hollis, 1800 Kentucky Ave., Paducah *ABX*

*Latham, James K.; *see* Howard K. Bell

*Mason, Clyde P., 507 Lafayette Ave., Lexington *ABCG*

Watkins, J. Stephen, 446 E. Hight St., Lexington *ABCJK*

*Welch, Marion C., 3522 Graham Rd., Louisville 7 *ABC*

LOUISIANA

*Applewhite, S. V., 424 Millaudon St., New Orleans 18 *AB*

Bedell & Nelson, Inc., 1200 St. Charles Ave., New Orleans *ABCJK*

*Boyd, J. S., & Assocs., 2026 DeSoto St., Shreveport *ABCG*

De Fraites Assocs., *Arthur A. De Fraites, Box 936, Houma *B*

De Laureal & Moses, Inc., *W. David De Laureal, 929 Howard Ave., New Orleans 12 *ABGJK*

*Dornblatt, B. M., & Assocs., Inc., 826 Lafayette St., New Orleans 12 *ABCFGJKM*

*Ernst, T. Edward, Inc., 2800 Jefferson Hwy., Box 10306, New Orleans 21 *ABGJKL*

Fromherz Engrs., *Frank C. Fromherz, 816 Howard Ave., New Orleans *ASCGJK*

*Harris, Elbert F., 1004—8th St., Alexandria

*Nelson, Waldemar S.; *see* Bedell & Nelson

*Rice, George P., Audubon Bldg., New Orleans 16 *ABK*

Roessle & Galloway, *Everett G. Roessle, 3213 Metairie Rd., Metairie *AB*

MAINE

*Caruthers, Dale E., Masonic Bldg., Gorham *ABG*

*Jordan, Edward C., Co., 379½ Congress St., Portland *AB*

MARYLAND

Baker, Wibberley, & Assoc., Inc., 49 N. Jonathan St., Hagerstown *ABGN*

*Beavin, Benjamin E., 104 E. 25th St., Baltimore 18 *ABEFG*

*Cox, Burton N., Jr.; *see* Rummel, Klepper & Kahl

*Custer, David J.; *see* Baker, Wibberley & Assoc.

Herz, Henry, 6926 Wilson Lane, Bethesda 14 *L*

*Hopkins, Edward Scott, 410 Professional Bldg., Baltimore 1 *B*

*Knoedler, Elmer L.; *see* Sheppard T. Powell & Assocs.

Matz, Childs & Assocs., Inc., 2129 N. Charles St., Baltimore 18 *ABCFG*

McCord, Kenneth A.; *see* Whitman, Requardt & Assocs.

McGavock, C. B., 3644 Keswick Rd., Baltimore 11 *E*

*North, Ernest C.; *see* Whitman, Requardt & Assocs.

*Powell, Sheppard T., & Assocs., 330 N. Charles St., Baltimore *ABCDEFGKMN*

*†Regnier, Raymond C.; *see* Whitman, Requardt & Assocs.

Rummel, Klepper & Kahl, 1021 N. Calvert St., Baltimore 2 *ABCEFG*

Sammons, William H., 8714—63rd Ave., Berwyn Heights *ABCFGM*

Van Reuth & Weidner, Inc., *A. G. Van Reuth, 411 Tunbridge Rd., Baltimore 12 *AB*

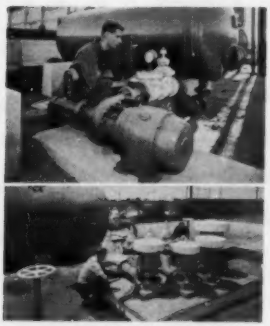
*†Vollmer, A. Russell; *see* Whitman, Requardt & Assocs.

Whitman, Requardt & Assocs., 1304 St. Paul St., Baltimore 2 *ACL*

(*Continued on page 184*)

"These Peerless pumps deliver practically all of the 18 million gallons of water we distribute daily."

Says Thomas J. Clemmer, Operations Manager, Dominguez Water Corporation, Long Beach, Calif.



"During the past 14 years many of our Peerless pumps have been changed but only to increase our capacity."

"Many of our Peerless pumps have seen 25 or more years of continuous service and downtime for repairs is practically non-existent."

Throughout their system, Dominguez makes virtually constant use of 37 individual Peerless pumps ranging from tiny 2 hp Fluidyne models to giant 250 hp deep well turbine pumps to insure a constant flow of water to their 18,000 customers.

Standardize on Peerless pumps for all your water supply and pumping needs. Like the Dominguez Water Corporation, you'll find Peerless pumps last longer, cost less to maintain and do the job better. For full details on Peerless pumps for your application, write us or contact your Peerless representative.

PEERLESS PUMP
HYDRODYNAMICS DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 WEST AVENUE 26, LOS ANGELES 31, CALIFORNIA

(*Continued from page 182*)

MASSACHUSETTS

*Adams, John C., Jr.; *see* Coffin & Richardson

*Burlingame, Roland S.; *see* Camp, Dresser & McKee

Camp, Dresser & McKee, *†Thomas R. Camp, 18 Tremont St., Boston 8 *BCDEFGM*

*†Chase, E. Sherman; *see* Metcalf & Eddy

*†Cobb, Edwin B.; *see* Metcalf & Eddy

Coffin & Richardson, Inc., *George W. Coffin, 68 Devonshire St., Boston 9 *ABCEFGJKL*

*†Culver, Robert H.; *see* Camp, Dresser & McKee

Fay, Spofford & Thorndike, Inc., 11 Beacon St., Boston *ABCEG*

*†Howard, Paul F.; *see* Whitman & Howard

*†Kinsel, Harry L.; *see* Metcalf & Eddy

*†**Knowlton, Kenneth F.,** 74 Conant St., Beverly *BDGM*

*Lawler, Joseph C.; *see* Camp, Dresser & McKee

*†Marston, Frank A.; *see* Metcalf & Eddy

Metcalf & Eddy, 1300 Statler Bldg., Boston 14 *BN*

*†Root, Darrell A.; *see* Camp, Dresser & McKee

*†**Stanley, William E.,** 77 Massachusetts Ave., Cambridge 39 *B*

*†Swab, Bernal H.; *see* Camp, Dresser & McKee

Weston & Sampson, 14 Beacon St., Boston 8 *ABCDEFGN*

Whitman & Howard, Inc., 89 Broad St., Boston *ABCEG*

MICHIGAN

***Allx, Neree D.,** 30729 Greenfield, Southfield *AB*

Ayres, Lewis, Norris & May, *Louis E. Ayres, 500 Wolverine Bldg., Ann Arbor *BGJL*

*Bogue, Stuart H.; *see* Pate & Hirn

*†**Boyce, Earnest,** 1601 Granger Ave., Ann Arbor *BF*

*Bunting, William E.; *see* Commonwealth Assocs.

Burt, Edward M.; *see* Williams & Works

Carlson, Carl H.; *see* Flint Surveying & Eng. Co.

Commonwealth Assocs., Inc., 209 E. Washington Ave., Jackson *ABCJKL*

Edmands Eng., *Horace J. Edmands, 303 Phoenix Bldg., Bay City *A*

Fishbeck, Ken, 2117 W. St. Joseph, Lansing 15 *AB*

Flint Surveying & Eng. Co., 2320 Lippincott Blvd., Flint *AB*

*†**Gibson, William C.,** School Public Health, Univ. of Michigan, Ann Arbor *C*

Hamilton, Weeber & Ward, 354 Houseman Bldg., Grand Rapids 2 *ABEG*

*Hirn, W. C.; *see* Pate & Hirn

*Holland, John M.; *see* McNamee, Porter & Seeley

Johnson & Anderson, Inc., 24187 Ryan Rd., Warren *ABCEGL*

Keck, William G., Assocs., Inc., Box 107, East Lansing *EF*

***Kurzy, Peter P.,** 3904 La Salle St., Jackson *AB*

***Leach, Arthur H.,** 3880 Grotto Rd., Bridgeport *AB*

Linck, Charles J.; *see* William G. Keck Assocs.

McNamee, Porter & Seeley, 2223 Packard Rd., Ann Arbor *ABEFGKM*

Michigan Assocs., 221 N. Cedar St., Lansing 29 *ABCDEFGHLM*

Norton & Kobbins, Inc., *John C. Norton, 111 S. Union St., Traverse City *ABCEGJK*

***Orr, Edwin M.,** 22148 Michigan, Dearborn 7 *AB*

Pate & Hirn, Inc., 532 Michigan Bldg., Detroit 26 *AB*

*†Snell, John R.; *see* Michigan Assocs.

***Snyder, George E.,** 1318 Wildwood Ave., Jackson *ABG*

Spicer Eng. Co., *Clifford H. Spicer, 818 S. Michigan Ave., Saginaw *AB*

*Thompson, J. Paul, Jr.; *see* Ken Fishbeck

*Turney, William G.; *see* Michigan Assocs.

*Van Eyck, Marvin; *see* McNamee, Porter & Seeley

Weeber, Earl R.; *see* Hamilton, Weeber & Ward

Williams & Works, *†T. C. Williams, 238 Ottawa, N.W., Grand Rapids *ABEFGL*

MINNESOTA

Carter, Krueger & Assocs., Inc., *Archie N. Carter, 3381 Gorham Ave., Minneapolis 26 *A*

Caswell Eng. Co., *Keith P. Caswell Jr., 1318 Valders Ave., Minneapolis *ABG*

Clark, K. M., Eng. Co., 2815 Wayzata Blvd., Minneapolis 5 *ABG*

*Fredrickson, Ralph P.; *see* K. M. Clark Eng. Co.

Lindsey Eng. Co., *James A. Lindsey, 5101 W. 50th St., Edina *ABFGH*

Orr-Schelen, Inc., 1104 Currie Ave., Minneapolis 3 *BG*

*Robinson, Wilbur R.; *see* Orr-Schelen, Inc.

Ruble, Earl H., 519 Lyceum Bldg., Duluth 2

Schoell & Madson, *William D. Schoell, 2629 Louisiana Ave. S, Minneapolis 26 *ABEFGH*

Stewart & Walker, Inc., *Douglas H. Stewart, 324 E. 2nd St., Thief River Falls *AB*

MISSISSIPPI

Damon Engrs., *Henry E. Damon, Box 1924, Meridian *A*

***Young, Robert H., & Assocs.,** Barnett Bldg., Box 1026, Jackson *ABCG*

MISSOURI

Black & Veatch, 1500 Meadow Lake Pkwy., Kansas City *ABCDEFGJKL*

*Brichan, Erwin R.; *see* Horner & Shifrin

Burns & McDonnell Eng. Co., 4600 E. 63rd St. Trafficway, Box 173, Kansas City *ABCFGJK*

Culbreath, M. C.; *see* Burns & McDonnell Eng. Co.

*Cunningham, Leo L.; *see* Burns & McDonnell Eng. Co.

Davis, Richard O.; *see* Burns & McDonnell Eng. Co.

Dodd, D. N.; *see* Burns & McDonnell Eng. Co.

*Farmer, Ed; *see* Black & Veatch

*†Filby, Ellsworth L.; *see* Black & Veatch

*Gibbs, William R.; *see* Black & Veatch

*†Hands, Glenn F.; *see* Burns & McDonnell Eng. Co.

*†Haney, Paul D.; *see* Black & Veatch

*Hardy, Bruce A.; *see* Horner & Shifrin

*Hasegawa, George K.; *see* Horner & Shifrin

Haskins, Sharp & Ordelheide, 1009 Baltimore Ave., Kansas City 5

*Hoppe, T. C.; *see* Black & Veatch

Horner & Shifrin, 1221 Locust St., St. Louis 3 *ABCEFGJKL*

*Kincaid, R. G.; *see* Burns & McDonnell Eng. Co.

Kirkwood, A. C., & Assocs., 7800 The Paseo, Kansas City *ABCGJKL*

*Lischer, Vance C.; *see* Horner & Shifrin

Meals, J. W.; *see* Burns & McDonnell Eng. Co.

***Reitz, Henry M.,** 101 S. Meramec Ave., St. Louis 5 *EN*

*†Robinson, Thomas B.; *see* Black & Veatch

Russell & Axon, *†George S. Russell, 408 Olive St., St. Louis 2 *ABCF*

*Scott, Guy R.; *see* Black & Veatch

*Shifrin, Walter G.; *see* Horner & Shifrin

Shockley Eng. Co., *C. A. Shockley, Rm. 203, 216 E. 10th St., Kansas City 6 *ABCG*

*Tucker, Arthur L.; *see* Horner & Shifrin

*†Veatch, N. T.; *see* Black & Veatch

*Wisely, F. E.; *see* Horner & Shifrin

***Wolf, Herbert C.,** 11324 Larimore Rd., St. Louis 38 *ABG*

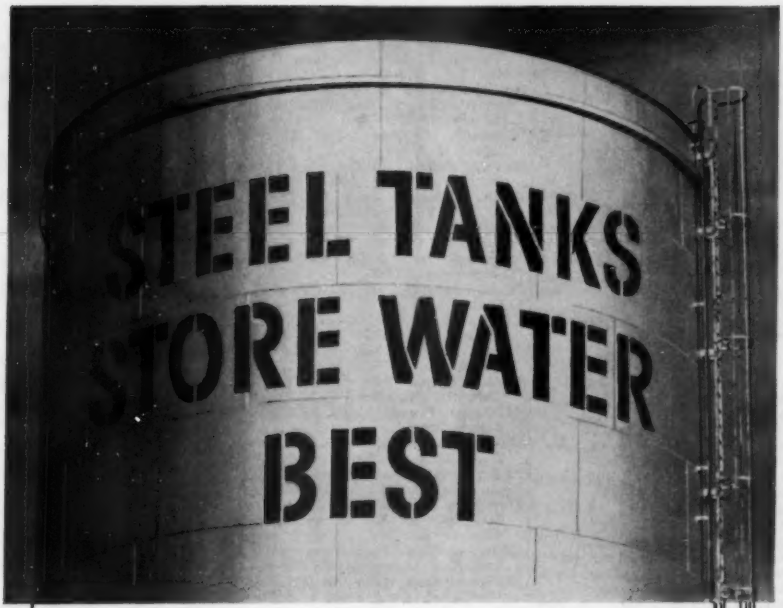
Wymore, A. H.; *see* Burns & McDonnell Eng. Co.

MONTANA

Eyer Eng., *Chet Eyer, 1040 N. 25th St., Billings *ABFGH*

Wenzel & Co., *†William J. Wenzel, 4035 10th Ave. S., Great Falls *ABCEFGHJKMN*

(*Continued on page 186*)



Whatever your community needs in water storage, General American offers you many advantages. The Plate and Welding Division has more than 40 years experience in fabricating large steel structures. Shops at many locations, and strategically-based field erection crews make it possible for General American to do the job efficiently in any part of the country.

Only STEEL Tanks are built to AWWA SPECIFICATIONS

It pays to plan with General American

Plate & Welding Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street · Chicago 90, Illinois
Offices in Principal Cities

PLATE & WELDING DIVISION GENERAL AMERICAN TRADE MARK

(*Continued from page 184*)

NEBRASKA

*Benjamin, Edwin D.; *see* Thomas-Benjamin-Clayton

*Cramer, John W.; *see* Fulton & Cramer

Daly, Leo A., Co., 633 Insurance Bldg., Omaha 2 *ABGKL*

Fulton & Cramer, 922 Terminal Bldg., Lincoln 8 *ABCGJKL*

***Hoskins, Harold & Assocs.,** 1630 Q St., Lincoln *ABCEFGHJ*

Kirkham, Michael, & Assocs., 508 S. 19th St., Omaha *ABJK*

*†Meier, E. Bruce; *see* Kirkham, Michael & Assocs.

Thomas-Benjamin-Clayton, Box 783, Grand Island *ABEH*

*Wells, William J., Jr.; *see* Kirkham, Michael & Assocs.

NEW JERSEY

*Barron, Donald W.; *see* Albert F. Ganz

***Boesch, Charles W.,** Hwy. 24, R. D. 1, Hackettstown *A*

***Brumbaugh, John, & Assocs.,** Mahwah *AB*

***Burris, Michael M.,** 485 Engle St., Englewood *ABFGH*

***Capen, Charles H.,** Box F, Newfoundland *BCFG*

***Critchlow, Howard T.,** 577 Rutherford Ave., Trenton 8 *BEFG*

Daniels, P. N., 183 Maple Shade Ave., Trenton 90 *B*

Ganz, Albert F., Inc., 5 Vose Ave., South Orange *M*

***Gardner, Marvin B., Jr.,** 15 E. Westfield Ave., Roselle Park, *BDK*

*†Homack, Peter; *see* Elsan T. Killam Assocs.

Johnson, Meredith, 113 Cadwalader Dr., Trenton 8 *E*

Killam, Elson T., Assocs., Inc., 48 Essex St., Millburn *BG*

***Kupper, Charles J.,** 15 Shelton Rd., New Market *ABCG*

***Luce, Arthur T.,** Plainfield Rd., Metuchen *BCGL*

*†**Purcell, Lee T.,** 36 De Grasse St., Paterson *BCDEFGMN*

Senesy & Van Nest, *John J. Senesy, Box 311, Bound Brook *ACFG*

***Streander, Philip B.,** 468 Walton Rd., Maplewood *BG*

NEW MEXICO

***Chafetz, Arthur B.,** Box 909, Carlsbad *ABEFGJK*

*†**Turney, William F., & Assocs.,** 312 Montezuma Ave., Santa Fe *ABCEFGHJLMN*

NEW YORK

***Austin, Robert W.,** 36 State St., Albany *CL*

*†**Baffa, John J.,** 75 West St., New York 6 *ABCEFGH*

Baldwin & Cornelius Co., 101 S. Bergen Pl., Freeport *ABG*

Blum, Louis D., 110 E. 42 St., New York 17 *L*

Bogert, Clinton, Engrs., 145 E. 32 St., New York 16 *ABCFG*

*†**Borden, Olney,** 109 Dwyer Ave., Liberty *AB*

Bowe, Albertson & Assocs., *Thomas F. Bowe, 75 West St., New York 6 *BN*

Bowne, Sidney B., & Son, *Sidney B. Bowne Jr., 161 Willis Ave., Mineola *ABGF*

*Briganti, Theodore; *see* Brown Engrs.

Brown Engrs., 10 Columbus Circle, New York 18 *ABEFGHJK*

Buck, Seifert & Jost, 112 E. 19 St., New York 3 *BCGLN*

***Caird, James M.,** Cannon Bldg., Troy *BD*

***Carman, S. P.,** 149 Leroy St., Binghamton *BCGL*

*Case, Egbert D.; *see* The Pitometer Assocs.

Cherry & Preble, 87 W. Tupper St., Buffalo 2 *ABG*

*†Cole, E. Shaw; *see* The Pitometer Assocs.

Cook Engrs., *John Cook, 513 E. Main St., Watertown *AB*

*†Ditmars, Donald M.; *see* Clinton Bogert Engrs.

Eastern Biochemical Labs., 159-07—14th Ave., Queens 57 *DN*

***Field, William T.,** 407 Trust Co. Bldg., Watertown *ABCEGL*

Geraghty & Miller, James J. Geraghty, 60 E. 42 St., New York 17 *EF*

Gibbs & Hill, Inc., Pennsylvania Sta., New York 1 *ABCGJKN*

Haberer Lab., James H. Haberer, 108 Lynch Ave., Utica 4 *BDN*

Halstad, R. J.; *see* Malcolm Pirnie Engrs.

*†Hardin, Eugene A.; *see* Parsons, Brinckerhoff, Quade & Douglas

*Harlow, Eugene; *see* Frederic R. Harris

Harris, Frederic R., Inc., 144 E. 44 St., New York 17 *AEFG*

Havens & Emerson, 233 Broadway, New York 7 *ABGN*

Hazen & Sawyer, 360 Lexington Ave., New York 17 *BCDEFGL*

***Henderson, Angus D.,** 210-07—29th Ave., Bayside *BCEFGJKL*

Henderson, Kenneth W.; *see* Malcolm Pirnie Engrs.

Holzmacher, Henry G., & Assocs., 500 Broad Hollow Rd., Melville *ABCDGN*

*Holzmacher, Robert G.; *see* Henry G. Holzmacher & Assocs.

*†Hudson, H. E., Jr.; *see* Hazen & Sawyer

*†**Ingram, William T.,** 20 Point Crescent, Whitestone 57 *BN*

*†**Kestner, Joseph A., Jr.,** 189 N. Lake Ave., Troy *BEG*

Leggette, Brashears & Graham, R. M. Leggette, 551—5th Ave., New York 17 *EF*

*Lincoln, Robert A.; *see* Clinton Bogert Engrs.

Lozier Consultants, Inc., 10 Gibbs St., Rochester 4 *ABEFG*

*†McLendon, Samuel C.; *see* H. G. Holzmacher & Assocs.

*†McPhee, Walter T.; *see* Nebolsine, Toth, McPhee Assocs.

Miller, David W.; *see* Geraghty & Miller

***Miller, Thomas G.,** 203 N. Aurora St., Ithaca *ABG*

*†Mitchell, Robert D.; *see* Malcolm Pirnie Engrs.

*Moyer, Everett R.; *see* Malcolm B. & Edwin L. Moyer

Moyer, Malcolm B. & Edwin L., Box 25, Colvin Sta., Syracuse 5 *JK*

***Myrick, George C., & Assocs.,** 93 State St., Albany 7 *ABCEFG*

Nebolsine, Toth, McPhee Assocs., 505 Park Ave., New York 22 *ABCEFGHL*

***Newsom, Reeves,** Scarswold Bldg., Scarsdale *CGL*

Nussbaumer, Clarke & Velzy, Inc., *†Newell S. Nussbaumer, 327 Franklin St., Buffalo *ABC*

O'Brien & Gere, *†Earl F. O'Brien, 400 E. Genesee St., Syracuse 2 *ABCGL*

*†Ordway, Edward S.; *see* Havens & Emerson

***Palevsky, Gerald,** 61 Kalda Ave., New Hyde Park *B*

*Papp, Remig A.; *see* Hazen & Sawyer

Parsons, Brinckerhoff, Quade & Douglas, 165 Broadway, New York 6 *B*

Pirnie, Malcolm, Engrs., 25 W. 43rd St., New York 36 *ABCEFGHL*

Pitometer Assocs., The, 50 Church St., New York 7 *ABG*

***Pratt, Charles H.,** 706 Fellows Ave., Syracuse 10 *ABCGL*

*Preble, Stephen E.; *see* Cherry & Preble

***Riddick, Thomas M. & Assocs.,** 369 E. 149th St., New York *BDGN*

*†Seifert, William P.; *see* Buck, Seifert & Jost

Shapiro, Robert; *see* Eastern Biochemical Labs.

Smith & Hershey, *Meloy Smith, 31 Exchange St., Rochester 14 *ABEFG*

*Squire, A. Bradford; *see* Lozier Consultants

*†**Staunton, Jack L.,** 235 Park Ave. S., New York 3 *ABFGH*

Stearns & Wheler, *†Donald E. Stearns, 99 Albany St., Cazenovia *BG*

***Symons, George E.,** 86 Edgewood Ave., Larchmont *B*

Ward & Moore, *Richard C. Ward, Box 178, Corning *ABG*

Water Service Labs., Inc., 615 W. 131 St., New York 27 *BDN*

***Wendel, Leon H.,** 7405 Canal Rd., R.D. 4, Lockport *ABCGJK*

*Wheler, A. Gordon; *see* Stearns & Wheler

*Whitlock, Ernest W.; *see* Malcolm Pirnie Engrs.

***Woodward, Kenneth G., & Assocs.,** 13 E. Main St., Webster *AB*

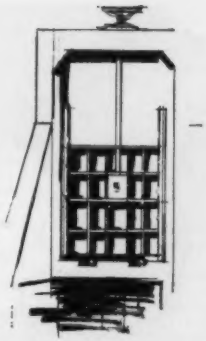
NORTH CAROLINA

*Barlow, Willis D.; *see* L. E. Wooten & Co.

Colburn & Gove Co., *Burnham S. Colburn Jr., 542 McDowell St., Asheville *ABFG*

*†Davis, Paul D.; see Piatte & Davis & Assocs.

(*Continued on page 188*)



Rely on ARMCO for low-cost water pipe... rugged, durable gates

Steel Strong, Durable, Economical

New steels are born at Armco

Armco Steel Water Pipe can save you money. Diameter-wall thickness combinations to fit practically every requirement enable you to select *exactly* what you need without paying for extra steel. And with Armco Water Pipe you can get fittings already attached, reducing the number of field joints.

Armco Slide or Sluice Gates *stay* serviceable year after year, thanks to adjustable wedge blocks at the sides to assure positive seating. For severe corrosive conditions, high-strength Stainless Steel Stems are available on Armco Gates.

Get details about these two economical Armco products. Write to **Armco Drainage & Metal Products, Inc., subsidiary of Armco Steel Corporation, 6881 Curtis Street, Middletown, Ohio.**

ARMCO Drainage & Metal Products

(*Continued from page 186*)

*Dickson, W. K., & Co., 404½ S. Tryon St., Charlotte *ABCEFG*
*Gardner, Walter A.; *see* Harrison Eng. Co.
Harrison Eng. Co., 1628 Wilkinson Blvd., Gastonia *ABCDFG*
Main, Charles T., Inc., 1415 Wachovia Bldg., Charlotte 2 *ACF*
*†Okun, Daniel A.; *see* Malcolm Pirnie Engrs.
Pease, J. N., & Co., Box 10336, Charlotte *ABCGJK*
Piatte & Davis & Assocs., 111 Corcoran St. Bldg., Durham *ABCFGJKL*
Pirnie, Malcolm, Engrs., Box 899, Chapel Hill *BG*
*†Rawlins, George S.; *see* J. N. Pease & Co.
*Safford, Truman H.; *see* Charles T. Main
Weiss, Charles M., Box 1368, Chapel Hill *BD*
Wooten, L. E., & Co., Box 2984, Raleigh *ABCGJK*

NORTH DAKOTA

***Burdick, L. W.,** 316 Cambridge St., Grand Forks *ABCEG*
Toman Eng. Co., *George J. Toman, Box 179, Mandan *ABCEFG*
*†**Velgel, L. W.,** Box 466, Dickinson *AB*

OHIO

*†**Barstow, E. D., & Assocs.,** 163 N. Union St., Akron 4 *ABEGL*
*†**Bird, Charles F., & Assocs.,** 656 High St., Worthington *ABFG*
Bonham, Kuck, Grant & Brundage, 4954 N. High St., Columbus *B*
Burgess & Niple, 2015 W. 5th Ave., Columbus 12 *ABGN*
***Dill, H. G., Co.,** 2607½ N. High St., Columbus 2 *ABG*
Engineering Assocs., 812 W. Liberty St., Wooster *AB*
Finkbeiner, Pettis & Strout, *†Carleton S. Finkbeiner, 2130 Madison Ave., Toledo 2 *ABCG*
*†Friend, Ardo M.; *see* Ralph L. Woolpert Co.
*Fuller, Raymond H.; *see* Burgess & Niple
Harvey, Russell, & Assocs., 1666 W. 1st Ave., Columbus 12 *ABEFG*
*Hatch, Bernard Franklin; *see* Burgess & Niple
Havens & Emerson, 640 Leader Bldg., Cleveland 14 *BCGN*
*†Henry, Thomas B.; *see* Jones, Henry & Williams
*Hockaden, George W.; *see* H. G. Dill Co.
Jennings-Lawrence Co., 1392 King Ave., Columbus 12 *ABG*
Jones, Henry & Williams, 2000 W. Central Ave., Toledo *ABCEFGH*
*†Krumm, Tahlman; *see* Burgess & Niple
***McClure, Harold R., Eng. Co.,** 3601 S. Dixie Hwy., Dayton 3º *AB*
Miller, Lynn M.; *see* Jones, Henry & Williams
*Murphy, James R.; *see* Engineering Assocs.
*O'Rourke, Robert B.; *see* Finkbeiner, Pettis & Strout
*†Palocsay, Frank S.; *see* Havens & Emerson
*†Pettis, Charles E.; *see* Finkbeiner, Pettis & Strout
*†**Riehl, Merrill L.,** 9555 Palmyra Rd., Canfield *BDMN*
Smith, Robert C., & Assocs., 16 Leland Ave., Columbus 14 *EF*
***Stepleton, H. A., & Assocs.,** 4528 Monroe St., Toledo 13 *B*
*†**Stilson, Alden E., & Assocs., Ltd.,** 245 N. High St., Columbus *ABCEGK*
*†Tatlock, Myron W.; *see* Ralph L. Woolpert Co.
Walker, Carl C.; *see* Russell Harvey & Assocs.
*White, Claude, Jr.; *see* Jennings-Lawrence Co.
Woolpert, Ralph L., Co., 360 W. 1st St., Dayton 2 *B*

OKLAHOMA

Benham Eng. Co. & Affiliates, *†David B. Benham, 215 N.E. 23rd St., Oklahoma City *ABCFGHJK*
Coston-Frankfurt-Short, 323 Madison, Oklahoma City *ABCJKM*
Curry Eng. Co., Box 1592, Muskogee *ABG*
Fell & Wheeler, Box 8127, Tulsa 15 *ABCEFGHJM*
*Frankfurt, W. Wally; *see* Coston-Frankfurt-Short
Ground Water Assocs., Box 480, Norman *E*
*McCoy, Robert L.; *see* Curry Eng. Co.
Moutrey, Curtis E., & Assocs., Inc., Box 6004, Tulsa 6 *CDGMN*
*†Shoebotham, Thomas B.; *see* Benham Eng. Co. & Affiliates
*†Wheeler, W. W.; *see* Fell & Wheeler

OREGON

*Bielman, Kenneth P.; *see* Cornell, Howland, Hayes & Merryfield
Caulfield & Caulfield, Pearson Bldg., Portland 4 *ABCFGHN*
Charlton Labs., David B. Charlton, Box 1048, Portland 7 *DN*
Clark & Groff, *†Lloyd K. Clark, 3240 Triangle Dr. S.E., Salem *ABCDGHL*
Cornell, Howland, Hayes & Merryfield, 1600 Western Ave., Corvallis *ABCEFGHJKM*
***Crichton, Robert M.,** 13—3rd St., Hood River *ABCFGH*
†Culp, Russell L.; *see* Cornell, Howland, Hayes & Merryfield
***Dorner, W. J.,** 429 S.W. 4th Ave., Portland 4 *ABG*
*†**Green, Carl E., & Assocs.,** 510 Henry Bldg., Portland 4 *ABCG*
***Haner, N. W., & Assocs.,** 220 S. W. Alder St., Portland 4 *BCFGH*
Huston & Lane, *D. A. Huston, 10154 S.W. Park Way, Portland 25 *ABG*
Martin Eng. Service, *Donald R. Martin, Box 302, Myrtle Creek *AB*
*Meigs, Gilbert R.; *see* Stevens & Thompson
*†Merryfield, Fred; *see* Cornell, Howland, Hayes & Merryfield
***Meyer, Robert E.,** 135 S.W. Farmington Rd., Beaverton *ABG*
*†**Perley, Willis F., & Assocs.,** 425 Builders Exchange Bldg., Portland 4 *B*
*†Rice, Archie H.; *see* Cornell, Howland, Hayes & Merryfield
Stevens & Thompson, 2234 S.W. 5th Ave., Portland *ABCFG*
Thompson, H. Loren; *see* Stevens & Thompson
***Willard, Ernest C.,** 919 Public Service Bldg., Portland *CL*
***Worthington, Richard T., & Assocs.,** 214 Hout Bldg., Corvallis *ABCEGKM*

PENNSYLVANIA

Albright & Friel, Inc., 3 Penn Center Plaza, Philadelphia *ABCDFG*
Bourquard, Geil & Assocs., *E. H. Bourquard, 1822 N. 2nd St., Harrisburg *ABFGH*
*Bradley, Mark E.; *see* Harris, Henry & Potter
Capitol Eng. Corp., Dillsburg *ABC*
Chester Engrs., The, 601 Suismon St., Pittsburgh 12 *ABCDGJKLMN*
*Curtin, Harry H.; *see* Roy F. Weston
Day & Zimmerman, Inc., 1700 Samson St., Philadelphia 3 *CL*
Engineering Development Co., Box 249, Coraopolis
*Fick, Henry H.; *see* Weber, Fick & Wilson
Gannett, Fleming, Corddry & Carpenter, Inc., 600 N. 2nd St., Harrisburg *ABCEFGJKLMN*
Gilbert Assocs., Inc., 525 Lancaster Ave., Reading *ABCDEFGJKN*
Glace & Glace, Inc., 2771 Paxton St., Harrisburg *ABCGN*
*Hallenburg, John K.; *see* Hill & Hill
*Hamilton, Hugh L.; *see* A. V. Smith Eng. Co.
***Hann, Victor A.,** 237 Lancaster Ave., Devon *BDL*
Harris, Henry & Potter, Inc., 114 E. 5th St., Chester *ABCGJKL*
*†Haseltine, T. R.; *see* The Chester Engrs.
*Herbert, Harry C.; *see* Glace & Glace
Hill & Hill, 8 Gibson St., North East *AB*
Jackson, J. O.; *see* Engineering Development Co.
*Keith, George W.; *see* The Chester Engrs.
***Kerr, S. Logan, & Co.,** Box 6, Flourtown *GKM*

(*Continued on page 190*)

here's what "out of sight out of mind" does to a water main

"Out of sight—out of mind" can be a mighty expensive philosophy in any water distribution system. The above unretouched photograph proves this point. It shows a badly tuberculated *eight inch* main whose *inside diameter was reduced to an average of almost 4.5 inches.* Resultant higher pumping costs with reduced pressure and carrying capacity make it costly to tolerate such conditions. That is why the savings effected in reduced pumping costs frequently pay for the *low cost* of National water main cleaning.

Since there's never a charge or obligation to inspect your mains, *call National now!*

Call in National today!

NATIONAL WATER MAIN CLEANING COMPANY

50 Church Street • New York, N. Y.

EASTERN SALES REPRESENTATIVE FOR PIPE LININGS, INC.

333 Candler Building, Atlanta 3, Georgia; 920 Grayson St., Berkeley, Calif.; 115 Peterboro St., Boston 15, Mass.; 533 Hollis Road, Charlotte, N. C.; 8 S. Dearborn St., Rm. 808, Chicago 3, Ill.; P. O. Box 385, Decatur, Ga.; 2024 Merced Ave., El Monte, Calif.; 315 N. Crescent St., Flandreau, South Dakota; 3707 Madison Ave., Kansas City, Missouri; 200 Lumber Exchange Bldg., Minneapolis 1, Minn.; 510 Standard Oil Bldg., Omaha 2, Nebraska; 2910 W. Clay Street, Richmond 21, Va.; 502 West 3rd South, Salt Lake City 10, Utah; 204 Slayton St., Signal Mountain, Tenn., 424 S. Yale Avenue, Villa Park, Illinois; 7445 Chester Avenue, Montreal, Canada; 576 Wall Street, Winnipeg, Manitoba, Canada; Apartado de Correos No. 5, Bogota, Colombia; Apartado 561, Caracas, Venezuela; P. O. Box 531, Havana, Cuba; Marquinaria, Apartado 2184, San Juan 10, Puerto Rico; Bolivar 441-A, Marafl., Lima, Peru, Radhusgaten 30, Oslo, Norway

(*Continued from page 188*)

*†Kiel, Paul M.; *see* Day & Zimmermann

Knowles, Morris, Inc., 1312 Park Bldg., Pittsburgh 22 *ABCGJK*

LeCates & Sacra, 30 S. Queen St., York *ABCGN*

LeVan, Howard A., Jr., 25 N. Front St., Harrisburg *ABCL*

*Lundberg, Herman; *see* The Chester Engrs.

*Mansfield, M. G.; *see* Morris Knowles

Means, Joel D.; *see* Yost Assocs.

*Morris, Walter K.; *see* Gannett, Fleming, Corddry & Carpenter

***Murdoch, William J.,** 600 Grant St., Pittsburgh 19 *ABCGN*

Quality Control Lab., Pine Rd., Fox Chase, Philadelphia 11 *D*

*Romano, James A.; *see* Gannett, Fleming, Corddry & Carpenter

*Sacra, William E., Jr.; *see* LeCates & Sacra

*†Simpson, Rolland W.; *see* Gilbert Assocs.

Smith, A. V., Eng. Co., Essex Bldg., Narberth *CGM*

*Smith, Robert E.; *see* Capitol Eng. Corp.

*Spray, Ronald F.; *see* William J. Murdoch

*Stroh, Charles Kirk; *see* The Chester Engrs.

Walker, John F. H.; *see* Roy F. Weston

Weber, Fick & Wilson, 1801 N. Front St., Harrisburg *CL*

*†**Weston, Roy F., Inc.,** 4 St. Albans Ave., Newtown Square *BCDFGLN*

*Wilber, Conrad C.; *see* Gannett, Fleming, Corddry & Carpenter

Yost Assocs., Inc., DuBois-Deposit National Bank Bldg., Dubois *ABCEFGJN*

Zimmermann, Albert F.; *see* Quality Control Lab.

SOUTH CAROLINA

*Anderson, S. Pickens; *see* Piedmont Eng. Service

***Barber, B. P., & Assocs., Inc.,** 1418 Marion St., Columbia *ABCEG*

Beebe, Hardwood Co., Spartanburg *H*

Murray Lab., J. J. Murray Jr., Box 1087, Greenville *DN*

Piedmont Eng. Service, Box 1717, Greenville *B*

Sirrine, J. E., Box 960, Greenville *ABC*

***Tindal, Robert T.,** 918 Henderson St., Columbia *B*

SOUTH DAKOTA

Banner, J. T., & Assocs., Inc., Legeros Bldg., Brookings *ABEG*

Schoell & Madson, 317 Iowa Ave. S.E., Huron *ABEGH*

*Vaudrey, Calvin; *see* J. T. Banner & Assocs.

*Vosler, Jack T.; *see* Schoell & Madson

TENNESSEE

Barge, Waggoner & Sumner, Inc., 1123 Church St., Nashville *BG*

Henshaw, Honeycutt & Lewis, Inc., *Jack A. Henshaw, 533 Stahlman Bldg., Nashville 3 *ABCDGM*

King Eng. Co., *Charles King, 214 Clay St., Kingsport *AB*

*†Owen, William Hunter; *see* Barge, Waggoner & Sumner

***Parker, J. Sanders, Engrs., Inc.,** 745 Berry Rd., Nashville 3 *B*

Wauford, J. R., & Co., *J. Roy Wauford Jr., Box 2081, Nashville 14 *ABCG*

TEXAS

*†Allen, Ocie C.; *see* Freese, Nichols & Endress

***Bowden, A. C.,** 1005½—13th St., Lubbock *ABEG*

*†Cooper, S. C.; *see* Parkhill, Smith & Cooper

*Endress, S. Gardner; *see* Freese, Nichols & Endress

*Fix, Robert E.; *see* Wisenbaker, Fix & Assocs.

*Fowler, James D.; *see* Koch & Fowler & Grafe

Freese, Nichols & Endress, 407 Danciger Bldg., Fort Worth *ABCFG*

Guyton, William F., 307 W. 12th St., Austin *EF*

***Hale, Isom H., & Assocs.,** 610 Scarbrough Bldg., Austin 1 *ABCEFGHLM*

Hatfield Eng. Co., *Glenn C. Hatfield, 509 W. 10th Ave., Amarillo *ABCG*

Koch & Fowler & Grafe, Inc., 3900 Lemmon Ave., Dallas 19 *ABCEG*

Koenig, Louis, 3702 Blanco Rd., San Antonio 12

Lockwood, Andrews & Newnam, Inc., Box 13332, Houston 19 *ABCFGJK*

Microbiology Service Labs., 4820 Old Spanish Trail, Houston 21 *DN*

*Newnam, Frank H., Jr.; *see* Lockwood, Andrews & Newnam

*Nichols, Robert L.; *see* Freese, Nichols & Endress

Parkhill, Smith & Cooper, 201 Ave. R., Lubbock *ABCEFG*

*Porter, Fred B.; *see* Southwestern Labs.

***Putney, R. J.,** 2120 S. Post Oak Rd., Houston 27 *ABCH*

***Rady, Joe J., & Co.,** 1606 Continental Life Bldg., Fort Worth *ABCFG*

*Remsburg, W. N.; *see* Joe J. Rady & Co.

Scherer, C. H., 3816 N.E. 12th St., Amarillo *BDMN*

***Shipman, R. Marvin, & Co.,** 202 W. Olmos, San Antonio *ABCG*

Silvey, J. K. G., Box 5216, N. Texas Sta., Denton *D*

Southwestern Lab., Box 1379, 2900 Cullen, Fort Worth 1 *DN*

Turner & Collie, Inc., *N. P. Turner, 3100 Eastside, Houston 6 *ABCFG*

Walsh & McLaren, *William C. Walsh, First National Bldg., Box 639 Angleton *B*

Wisenbaker, Fix & Assocs., 1500 Peoples National Bank Bldg., Tyler *BCDFG*

Wood, Edna; *see* Microbiology Service Labs.

Yeatts & Decker, *Ernest B. Yeatts, 202 Morris Bldg., Abilene *AG*

UTAH

*Alsup, Lawrence E.; *see* Templeton & Linke

Hansen Eng. Co., *Richard C. Hansen, Commercial Bank Bldg., Richfield *ABCEGH*

Hilbert, Robert; *see* Templeton & Linke

Poulsen, George W., Assocs., *George W. Poulsen Jr., 402 Dooly Bldg., Salt Lake City *ABCGHK*

Templeton & Linke, *Win Templeton, 211 Dooly Bldg., Salt Lake City *ABCFG*

VIRGINIA

Brockenbrough, Austin, & Assocs., 106 E. Cary St., Richmond 19 *ABCG*

Dobyns & Morgan, 18 W. Washington St., Lexington *ABCG*

Froehling & Robertson, Inc., Box 737, Richmond *BCDM*

Hayes, Seay, Mattern & Mattern, 1615 Franklin Rd. S.W., Roanoke *ABCEFGJKLM*

*Mattern, E. K.; *see* Hayes, Seay, Mattern & Mattern

*Morgan, James M., Jr.; *see* Dobyns & Morgan

Royer, R. Stuart, & Assocs., 15 W. Cary St., Richmond 20 *ABCFGL*

*Ruehl, Edward H.; *see* R. Stuart Royer & Assocs.

*†Talcott, George R.; *see* R. Stuart Royer & Assocs.

*Watlington, James E.; *see* Austin Brockenbrough & Assocs.

Weaver, Julian M.; *see* Froehling & Robertson

***Weeks, R. Kenneth,** 6165 E. Sewells Point Rd., Norfolk *ABCG*

WASHINGTON

Alger, Charles G.; *see* H. E. Bovay Jr.

Beck, R. W., & Assocs., 1500 Tower Bldg., Seattle *ABCFGJKL*

Bovay, H. E., Jr., Box 818, Richland *ABCGHJK*

Cornell, Howland, Hayes & Merryfield, *Holly A. Cornell, Logan Bldg., Seattle

Fisher, Ruskin, & Assocs., 17962 Midvale Ave., Seattle 33 *AB*

***Gardner, Roy L., & Assocs.,** 613 Arctic Bldg., Seattle 4 *ABCFGH*

Hill & Ingman, 3104 Western Ave., Seattle 1 *ABG*

*†Ingman, Gordon G.; *see* Hill & Ingman

***Kuehl, J. A.,** 3125 E. K St., Tacoma 4 *ACG*

*†Lyon, Charles R.; *see* Ruskin Fisher & Assocs.

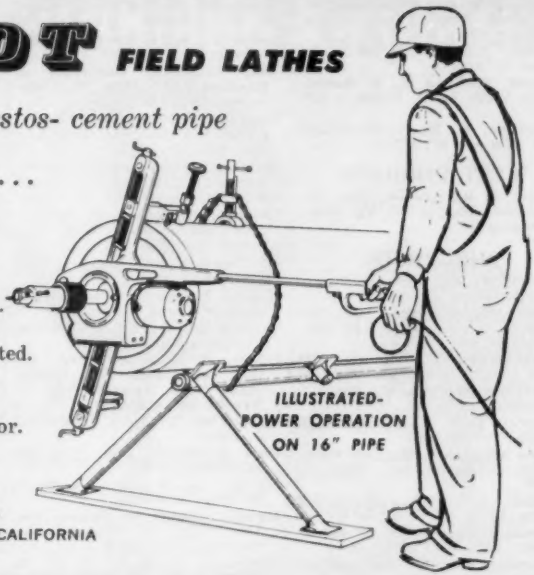
(*Continued on page 192*)

PILOT FIELD LATHES

machine asbestos- cement pipe

right on the job . . .

Make factory-like ends
on any length when
and where you need them.
No waiting — no delay.
Power or manually operated.
All sizes to 4" thru 20"
Write for details and
name of nearest distributor.



ILLUSTRATED-
POWER OPERATION
ON 16" PIPE

MANUFACTURED BY
PILOT MANUFACTURING CO.
20433 EARL ST., TORRANCE, CALIFORNIA
TELEPHONE: FRontier 6-0485

FILTER SAND AND GRAVEL

Well Washed and Carefully Graded to Any Specification. Prompt Shipment in Bulk or in Bags of 100 lb. Each.

Inquiries Solicited

NORTHERN GRAVEL COMPANY

P.O. Box 307 Muscatine, Iowa

(Continued from page 190)

Robinson & Robinson, John W. Robinson, 1315 S. 59th St., Tacoma 8 *EF*

*Wallace, John R., Jr.; *see* R. W. Beck & Assocs.

*†**Wolff, Richard E., & Assoc.,** 1506 Smith Tower, Seattle 4 *AB-EG*

***Worthen, F. R.,** 11908 Nyanza Rd., Tacoma 99 *ABCG*

WEST VIRGINIA

***Todd, A. R., Assocs., Inc.,** 906 National Bank of W. Va. Bldg., Wheeling *B*

WISCONSIN

*Becher, A. E., Jr.; *see* Becher-Hoppe Engrs.

Becher-Hoppe Engrs., Inc., *Archie E. Becher, 291 Grand Ave., Schofield *AB*

Donohue, Jerry, Eng. Co., 608 N. 8th St., Sheboygan *ABG*

***Gallaher, William U.,** Box 252, Appleton *BDN*

General Eng. Co., City Bank Bldg., Portage *ABG*

Green Eng. Co., *Kenneth Green, 1910 Mayflower Dr., Middleton *AB*

*Hamel, Vernon S.; *see* General Eng. Co.

*Hartman, Bruno J.; *see* Jerry Donahue Eng. Co.

*Koletzke, Max F.; *see* Lakeland Engrs.

Lakeland Engrs., 1 W. Main St., Madison *ABEG*

***Nicholson, R. W.,** 921½ Milwaukee Ave., South Milwaukee *ABEG*

*†**Strand, John A.,** 2020 University Ave., Madison 5 *ABEG*

WYOMING

***Baldwin, Thane H. J.,** Box 618, Basin *ABGH*

***Bereman, John S., & Co.,** Box 777, Court House, Cody *ABH*

Bishop & Spurlock, *Floyd A. Bishop, Box 598, Lander *ABFGH*

*†**Streeter, Robert L.,** Box 2010, Casper *ABEFG*

CANADA

*Ahern, P. C.; *see* Maritime Eng. Consultants

*Archibald, H. E.; *see* R. K. Kilborn & Assocs.

***Armstrong, C. G. Russell,** Bartlet Bldg., Windsor, Ont. *AB*

Atkins, W. S., & Assocs., Ltd., 33 Price St., Toronto 5, Ont. *ABD*

***Bernhart, Alfred P., Assocs., Ltd.,** 3768 Bathurst St., Toronto-Downsview, Ont. *BC*

Canadian-British Eng. Consultants, Box 93, Halifax, N.S. *ABCEFGH*

*Carignan, Louis-Georges; *see* Cote, Lemieux, Carignan & Bourque

*Case, C. William; *see* Todgham & Case

***Chagnon, Jacques,** 166 St. Louis St., St. Eustache, Que. *AB*

***Chisholm, W. O.,** 15 Watford Dr., Agincourt, Ont. *B*

*Clawson, W. K.; *see* M. M. Dillon & Co. (London)

*Cote, J. Marcel; *see* Surveyer, Nenniger & Chenevert

Cote, Lemieux, Carignan & Bourque, 144 Vimy N., Sherbrooke, Que. *AB*

***Couture, Louis P.,** Quebec Bridge Park Ave., Ste. Foy, Que. *ABG*

***Cumming-Cockburn & Assocs.,** *James D. Cumming, 5075 Yonge St., Willowdale, Ont. *B*

***Dayton, Martin J. J.,** Suite 3, 1865 Marine Bldg., West Vancouver, B.C. *BGH*

*de Cotrey, Gaston Rene; *see* La-Londe & Valois

*Dexter, William A.; *see* Haddin, Davis & Brown Co.

*Dickson, M. D. W.; *see* Newton, Dickson & Assoc.

Dillon, M. M. & Co., Ltd., Box 1026, 141 Maple St., London, Ont.; 88–90 Eglinton Ave. E., Toronto, Ont. *ABGJK*

*Fee, Arthur E.; *see* J. L. Richards & Assocs.

Gore & Storrie, Ltd., 1130 Bay St., Toronto *ABCG*

*Grover, L. W.; *see* Underwood, McLellan & Assocs.

Haddin, Davis & Brown Co., Ltd., 1520 W. Georgia, Vancouver 5, B.C. *ABG*

*Heffernan, Joseph J.; *see* M. M. Dillon & Co. (Toronto)

*Heinze, L. S.; *see* Canadian-British Eng. Consultants

Hopper, Duncan, & Assocs., Ltd., 1593 Wilson Ave., Downsview, Ont. *AB*

*Hopper, G. K.; *see* Duncan Hopper & Assocs.

***Ker, W. Alian, & Assocs.,** 543 Bastion St., Victoria, B.C. *BGH*

Kilborn, R. K., & Assocs., 36 Park Lawn Rd., Toronto 18, Ont. *ABCFGJK*

***Knight, R. Gordon, & Assocs., Ltd.,** 1100 Lonsdale Ave., North Vancouver, B.C. *BEFGH*

LaLonde & Valois, 615 Belmont St., Montreal 3, Que. *ABG*

Lamont, Archie G. W.; *see* W. S. Atkins & Assocs.

Lane, L. T.; *see* Lewis, Lane & Co.

***Lea, H. W.,** 39 Westminster Ave. S., Montreal W., Que. *ABCEFG*

***Lee, J. D., & Co., Ltd.,** 194 Ontario St., Kingston, Ont. *ABG*

Lewis, Lane & Co., Ltd., 127 Pine St., Sudbury, Ont. *ABE*

MacLaren, James F., Assocs., 321 Bloor St. E., Toronto, Ont. *ABG*

*MacLaren, James W.; *see* James F. MacLaren Assocs.

Maritime Eng. Consultants, 111 Inglis St., Halifax, N.S. *ABCGJKL*

*McDonald, Norman G.; *see* Gore & Storrie

*McFarland, W. I.; *see* Haddin, Davis & Brown

*McKay, W. G.; *see* Underwood McLellan & Assocs.

*McLean, M. D.; *see* Northland Eng.

Moffatt, Allan G.; *see* Haddin, Davis & Brown Co.

Newton, Dickson & Assocs., Ltd., 102 Rivalda Rd., Toronto, Weston, Ont. *AB*

Northland Eng., 643 Cassells St., North Bay, Ont. *AB*

***Potter, Russell E., & Assocs.,** 605 Courtney St., Victoria, B.C. *AB*

***Price, Jacques,** Box 340, Windsor, N.S. *ABC*

*Priestman, John; *see* Willis & Cunliffe

Proctor & Redfern, *G. E. M. Proctor, 75 Eglinton Ave. E., Toronto 12 *ABCGK*

***Reside, J. W., Eng., Ltd.,** Hebron, Yarmouth County, N.S. *ABG*

Richard, J. L., & Assocs., Ltd., 864 Lady Ellen Pl., Ottawa *ABCFGJK*

Stanley, Grimble, Roblin, Ltd., *†Donald R. Stanley, 8908—99th St., Edmonton, Alta. *ABFG*

*Stewart, Malcolm D.; *see* R. K. Kilborn & Assocs.

Surveyer, Nenniger & Chenevert, 1440 St. Catherine St., West Montreal, Que. *A*

***Tassie, Gilbert C.,** Berry Bldg., Vernon, B.C. *ABCFGH*

Todgham & Case, Box 386, Chatham, Ont. *AB*

Underwood, McLellan & Assocs., Ltd., 815—7th Ave. W., Calgary, Alta. *AB*

***Vezina, Maurice G.,** 19 Sunset Ave., Montreal, Que. *ABC*

Willis & Cunliffe Eng., Ltd., 536 Broughton St., Victoria, B.C. *ABGN*

***Woods, Sidney W.,** Rm. 301, Lister Block, Hamilton, Ont. *AB*

FOREIGN

Andritsos, Christoforos C.; *see* Doxiadis Assocs.

Bird, C. St. John, 201 Portland Pl., 37 Jorissen St., Braamfontein, Johannesburg, South Africa *ABFGHL*

Doxiadis Assocs., 24 Strat. Syndesmou, Athens, Greece *ABCEFGHJK*

***Gonzalez-Hurtado, Hernando,** Apdo. Nal 509, Cali, Colombia *BEFGH*

Hidrotecnica, Of. 4-B, Ed. Banco Mercantil y Agricola, Calle Real de Sab. Grande, Caracas, Venezuela *ABG*

Katavolos, George; *see* Litchfield, Whiting, Bowne & Assoc.

Litchfield, Whiting, Bowne & Assoc., Khiabane Villa, Arak, Tehran, Iran *ABFGJK*

*Moreau Meyer, Jose H.; *see* Oficina Tecnica de Ing. M.M.

Nicholls, F. Roy, 47 Victoria St., London, S.W. 1, England *JK*

Oficina Tecnica de Ing. M.M., Apdo. 8, Caracas, Venezuela *ABC*

Perkins, Philip H., Box 648, Nicosia, Cyprus *ABE*

*Vaghi, Edgardo; *see* Vapos

Vapos, Via G. Mellerio 4, Milan, Italy *BD*

*Viana A., Hugo; *see* Hydrotecnica

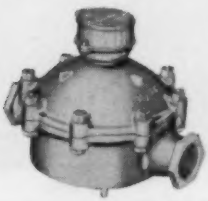
Meet 6 efficiency experts

NEW Badger *Easy-Read*

More bonus features than any other magnetic-drive meter can offer, including big, easy-to-read face (¼" high digits) and removable register. If yours is a Badger meter system, many parts in the new Easy-Read are interchangeable with the parts on your present meters.

Badger *Read-o-Matic**

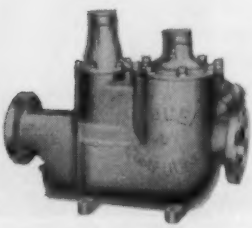
The first practical outdoor register in the industry, the Read-o-Matic offers faster, lower-cost reading for modern water meter systems.



Heavy-duty disc meters 1½" to 4"

Frostproof disc meters ⅝" to 1¼"

Turbine meters 2" to 12"



Compound meters 2" to 10"

*Pat. applied for in U.S.A. and foreign countries

Badger Meter Mfg. Co.

4545 W. Brown Deer Road, Milwaukee 23, Wis.

REGIONAL SERVICE CENTERS

Covina, California • Atlanta, Georgia • Long Island City, New York • Worcester, Massachusetts
BRANCH OFFICES in principal cities

Chicago Bridge & Iron Company

HORTON STEEL TANKS for Municipal Service

Write our nearest office for complete information or estimating figures on steel tanks for municipal service.

Offices

Atlanta
Birmingham
Boston
Chicago
Cleveland
Detroit
Houston
Kansas City
New Orleans
New York
Philadelphia
Pittsburgh
Salt Lake City
San Francisco
Seattle
South Pasadena
Tulsa

Plants

Birmingham
Chicago
Greenville, Pa.
Houston
New Castle, Del.
Salt Lake City

IN CANADA:

Horton Steel Works Limited

RADIAL CONE
1,000,000-gal. capacity at Winston Salem, N. C.

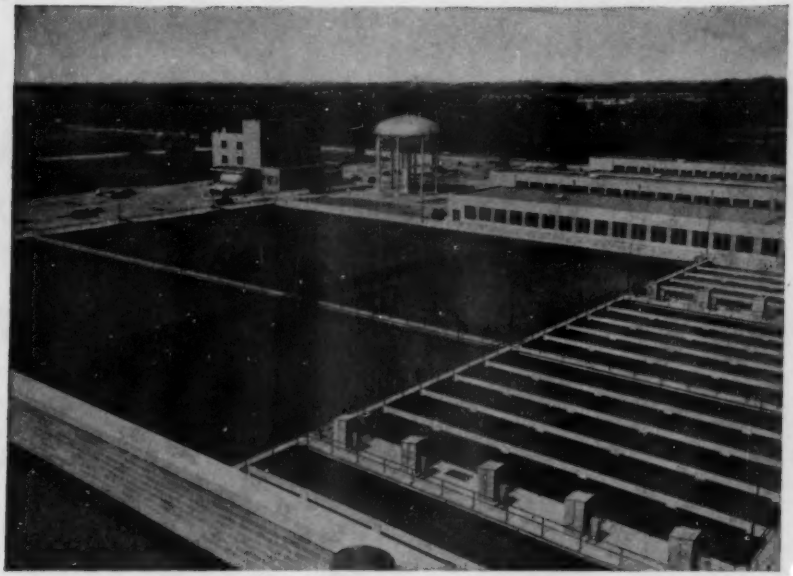
WATERSPHEROID
500,000-gal. capacity at Ocala, Fla.

WATERSPHERE
200,000-gal. capacity at Griffith, Indiana

SPHEROIDAL
2,000,000-gal. capacity at Forth Worth, Texas

ELLIPSOIDAL
500,000-gal. capacity at Manchester, Tenn.

HORTON STANDPIPE
1,000,000-gal. capacity at Clearwater, Fla.



Philadelphia's push-button treatment plant uses

DORR-OLIVER EQUIPMENT

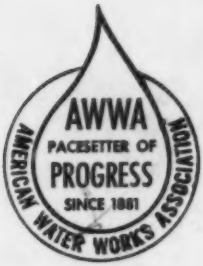
With the completion of the new Torresdale plant, Philadelphia not only fulfills its dream of a completely modern water treatment system, but also possesses a show place of advanced equipment and design ideas.

An extensive system of automatic and semi-automatic controls makes this literally a "push-button" plant. Contributing to its high efficiency are important items of Dorr-Oliver equipment. Four Dorrco Flocculators are installed, each with five rows of paddles 14′ dia. x 174′6″ long spaced on 19′7″ centers. There are also four Dorr Cross-Flow Squarex Clarifiers, each 174′6″ square x 19′6″ s.w.d. Maximum design capacity of the plant, one-half of which is shown above, is 423 MGD. Dorr-Oliver Incorporated, Stamford, Connecticut.

Consulting Engineers: Morris Knowles Inc., Pittsburgh, Pa. *Contractors:* McCloskey and Company, Philadelphia, Pa.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT


AWWA
PACESETTER OF
PROGRESS
SINCE 1881
AMERICAN WATER WORKS ASSOCIATION